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National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

REVIEW OF THE STATE OF WORLD FISHERY RESOURCES:

MARINE FISHERIES

Food and Agriculture Organization of the United Nations

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by

Marine Resources Service
Fishery Resources Division
Fisheries Department

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 1997

PREPARATION OF THIS DOCUMENT

The state of the world's fish stocks and aquaculture is reviewed every two years by the Fishery Resources Division for the FAO's Committee on Fisheries (COFI). Previous reviews included all capture fisheries and aquaculture, but for the Twentieth Session of COFI, March 1993, the Review was divided into two parts: the world's marine resources, and inland fisheries and aquaculture, identified respectively as Part 1 and Part 2 of *FAO Fisheries Circular* No. 710. Due to the increasing importance of aquaculture production, for the Twenty-first Session of COFI, March 1995, the Review was produced in three parts, each as a separate document under the same general title: "Review of the State of World Fishery Resources". The document dealing with Marine Fisheries was issued in 1995 as *FAO Fisheries* Circular No. 884, and provided an update of a major revision produced by the Marine Resources Service, the "Review of the State of World Marine Fishery Resources", issued in 1994 as *FAO Fisheries Technical Paper* No. 335.

This Circular is primarily produced as a background information document for the Twenty-second Session of COFI, April 1997, and updates the information provided in *FAO Technical Paper* No. 335, Review of the State of World Marine Fishery Resources, issued in 1994, and in *FAO Fisheries Circular* No. 884, Review of the State of World Fishery Resources: Marine Fisheries, issued in 1995. It is intended that the Review of the State of the World Marine Fishery Resources will be completely revised every six years, with updates provided biennially.

Relevant sections of this review have been produced by the authors indicated in the table of contents. J. Csirke was responsible for the general coordination and final editing of this document, with the valuable assistance of J. Cannon. R. Coppola and F. Carocci assisted with the preparation of tables and illustrations, C. Trabucco with the final formatting and design, and E. D'Antoni illustrated the front cover.

FAO Marine Resources Service, Fishery Resources Division.
Review of the state of world fishery resources: marine fisheries.
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ABSTRACT

This paper updates the regular reviews of the state of the world's marine fish stocks, based mainly on statistics through 1994. The introduction refers to the limits of world fish production and to major trends in world fisheries since 1950. Attention is drawn to the generalized high level of exploitation of the more valuable marine resources. More detailed remarks are provided for each FAO statistical area, together with a discussion of the major changes and trends that have occurred in specific resources and the fishery assessment strategies in current use in support of fisheries management in each region. Special sections address the global issue of tunas and tuna-like species and other special topics dealing with lanternfishes as a potential resource, and global synchrony in fish populations. Summary tables are provided for each statistical area showing historical and recent landings for the major marine resources and judgements on their current state of exploitation.

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A. INTRODUCTION

A first major review of the state of world fishery resources was produced by FAO more than two decades ago (J.A. Gulland (ed.), 1971. "The Fish Resources of the Ocean". Fishing News Books, England, 255p), and since then the FAO Fisheries Department has been producing periodical updates almost every two years. While these reviews and their updates are primarily intended as background documents for the regular sessions of the FAO Committee on Fisheries (COFI), they have proven to be most useful as background documents for other international meetings dealing with the conservation and management of marine living resources, as well as to individual fishery scientists and managers looking for a brief but comprehensive review of the state of world fishery resources.

The present document should be largely regarded as an update of the 1993 Review of the state of world marine fishery resources, issued as FAO Fisheries Technical Paper No. 335, and of its previous update, issued in 1995 as FAO Fisheries Circular No. 884. However, in addition to a new layout, this review provides information on fish production over an extended time series (1950-1994).

The analysis of this extended time series, now readily available in electronic form, has led to some interesting findings and general conceptual postulates regarding the general trends and potential of fisheries at global and regional scales. Some preliminary results of the analysis of these general trends are provided in the following two sections. A more detailed description of the state of exploitation and management by major regions will follow, to end with a section on special topics of general interest.

Each regional review is split into three main sections: the "Introduction", a "Profile of Catches" and a section on "Resource Status and Management". The "Introduction" describes the key geographical features and key attributes of the physical environment found within the specific FAO statistical area. In the introductory section there is also a brief summing up of the main points of current interest or concern within the FAO statistical area, whether they arise from long-term trends or patterns or recent changes in the fisheries. The "Profile of Catches" draws on the long-time series of catches on data recently collected into a single database by FAO to give a sense of the historical scale, development and relative importance of the various types of fisheries found within each FAO statistical area.

However, the main focus of each regional review is on recent developments within specific fisheries as described in the section on "Resource Status and Management". The structure of this section within each regional review varies to reflect the most appropriate basis upon which to separate the resources into meaningful components. In certain FAO statistical areas, separation into Exclusive Economic Zones is used, while in others a distinction is made according to resource type (e.g. demersal, pelagic). In other areas authors have followed the approach used by organization(s) charged with assessing or managing marine resources in that specific area. Wherever possible, the results of stock assessments are used to make quantitative comments on resource status directly. However, in many fisheries, particularly those which have developed recently, such information is not available. In such cases qualitative information may be presented. Additionally, in instances where catches are believed to be indicative of stock status, quantitative catches data may be discussed. The description and analyses of state of exploitation given in these sections make use of the best information currently available to FAO.

For each FAO statistical area a table containing catch data for each year from 1988 to 1994 and ten-year averages from 1950 to 1989 is given in Section D "Marine Resources Tables". Also contained in these tables are annotations on the state of exploitation of each resource (see the "Notes for all Tables" in section D for definitions). A certain degree of care must be taken in interpreting these annotations because they are given on a species-by-species basis, rather than for individual stocks. It is typically the case that within each FAO Statistical Area the catches of a given species will come from two or more distinct stocks. It is often the case that the state of exploitation of such separate stocks is different. In such instances the "state of exploitation" indicators in the table should be checked against the main narrative within the appropriate "Resource Status and Management" section for further details. Given this distinction between species and individual stocks, it can be seen that the "state of exploitation" notes have limited statistical significance from a fisheries management point of view and are intended as "rule of thumb" indicators only. It should also be noted that, while FAO believes that the principal marine species which are, or have been, the subject of exploitation are represented in the tables, the majority of species which contribute to many marine fisheries in lesser quantities are not included.

1. A PERSPECTIVE ON FISHERIES TRENDS OFFERED BY ESTIMATES OF PRODUCTION PER SHELF AREA

The growing use of Geographical Information Systems (GIS) technology and databases has allowed estimates of shelf area to be made for FAO statistical areas. Fishery production figures, otherwise expressed in terms of landings, can therefore be made more easily comparable by expressing them, as for agricultural and forestry resources, per surface area available for their production. When landings of shelf resources (bottom fish and invertebrates) and small- and medium-sized pelagic fish (living resources associated with, but not restricted to, shelf waters) are each expressed per surface area of continental shelf within the 200m depth by individual FAO statistical areas, certain surprising regularities

Table A1.1

FAO Area	Oceanic region	Shelf-dependent	North temperate	South temperate	Tropical	Ranking
47	SE Atlantic	4.629		XXX		1
61	NW Pacific	3.284	XXX			2
21	NW Atlantic	2.471(3.113*)	XXX			3
27	NE Atlantic	2.346	XXX			4
67	NE Pacific	2.036	XXX			5
81	SW Pacific	1.53		(XXX)		6
87	SE Pacific	1.445		(XXX)		7
41	SW Atlantic	0.982		(XXX)		8
51	W.Indian Ocean	0.852			(XXX)	9
77	EC Pacific	0.738			XXX	10
37	Mediterranean	0.704	(???	———	???)	11
57	E. Indian Ocean	0.65			(XXX)	12
34	EC Atlantic	0.642			XXX	13
31	WC Atlantic	0.578			XXX	14
71	WC Pacific	0.444			(XXX)	15
	MEAN RANKING		3.5	5.75	11.8	

* : Estimate for southern NAFO areas 2.0+ only
( ) : Peak value for 1990-94

emerge. At least half of the marine statistical areas (Table A1.1) realized peak production figures at some time previous to the last five-year period of 1990-94, (especially for areas in the Northern hemisphere), and these peak values show marked similarities within given ranges of latitudes. It is also possible in this way to compare peak production values between areas subject to different climatic and oceanographic conditions.

Table A1.2

5-yr averages	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94
FAO's Statistical Area								
47 SE Atlantic			4.629					
			4.569					
			9.283					
21 NW Atlantic			2.471					
				1.09				
				3.228				
27 NE Atlantic						2.346		
					2.103			
					4.458			
31 WC Atlantic						0.578		
						0.744		
						1.374		
34 EC Atlantic					0.842			
							3.746	
								4.847
67 NE Pacific							2.038	
		0.209						
							2.103	
61 NW Pacific							3.284	
							2.965	
							6.382	
77 E. Central Pacific							0.738	
							1.543	
							3.102	
37 Mediterranean and Black Sea								0.704
						1.808		
							2.512	
41 SW Atlantic								0.982
				0.161				
								1.092
81 SW Pacific								1.53
							0.371	
								1.974
87 SE Pacific								1.445
								25.046
								26.84
71 W. Central Pacific								0.444
								0.516
								1.218
51 W. Indian Ocean								0.852
								0.669
								1.892
57 E. Indian Ocean								0.65
								0.59
								1.324

shelf-dependent species
shelf-associated species
total

As far as the shelf resources are concerned, there is a marked similarity in peak production per shelf area between FAO statistical areas in the northern hemisphere, where former peak production levels clustering around 2.7 t/km^2 were realized, and comparable arcto-boreal areas in the Southern Hemisphere, where peak levels were lower at some 2.15 t/km^2 (Table A1.2). The exception to this pattern was the Southeast Atlantic, whose peak levels were much higher during intensive exploitation by distant water fleets in the 1960s and 1970s.

Statistical areas which lie in the tropics also show a similar clustering of production figures, with peak production levels for shelf resources that are much lower, at some 0.74 t/km^2. Similar figures were obtained for the Mediterranean (0.70t/km^2). Obviously, there are 'hot spots' within each area where local production levels are much higher, such as estuaries and coral reefs, but the average productivity over the whole shelf appears more to reflect natural restraints due to nutrient supply, especially once fishing effort has exceeded optimal levels.

The role of nutrient supply seems to be most evident with respect to pelagic resources, where peak production figures vary from 0.5 t/km^2 for areas with stratified, nutrient-poor water masses to as high as 25 t/km^2 in FAO Statistical Area 87, where the most important upwelling-driven pelagic fishery in the world occurs. Peak pelagic productivity is clearly associated with upwellings in the tropics and sub-tropics but, interestingly enough, upwelling systems are not especially conducive to high production of shelf invertebrates and bottom fish, probably because of environmental instability and the low oxygen conditions that strong upwellings occasionally lead to. In cold-temperate seas, high pelagic production is associated with tidal mixing of nutrient-poor surface and nutrient-rich bottom waters, especially on the extensive continental shelves of the Northern hemisphere.

Obviously, there are tropical areas (such as the Western Indian Ocean) where significant increases in production of tunas and mesopelagic fish may be realizable given strong upwellings, but for most other tropical areas, other than those with locally high production areas associated with coral reefs and estuaries, further increases in production are constrained by nutrient supply. Such nutrient supply is generally poor in stratified tropical waters, and fishery productivity usually drops off rapidly with depth. Here, despite a relatively short history of intensive fishing, there appears to be limited future potential for further increases in production per shelf area, and if there such a potential, this seems likely to come from further exploitation of small pelagic resources and tunas.

2. DEVELOPMENT TRENDS AND POTENTIAL

During the period considered by the first estimate of world potential production based on analysis of historical landings made in FAO by J. Gulland[1] in 1971, landings were increasing at about 6% per year (Figure A2.1), and Gulland estimated that the potential for traditionally exploited marine species was about 100 million tonnes per year. This estimate of fishery potential was consistent with estimates made earlier by several other authors (see Moiseev[2], p. 203), based on different analyses. In fact, the growth rate for marine production observed by FAO soon fell, although some growth was maintained. Despite fisheries developing on non-traditional species, the marine fishery production has so far only reached about 90 million tonnes (in 1994) with capture fisheries accounting for 84 million tonnes.

Marine fishery production since 1950, showing the data utilised for the 1971 assessment by Gulland and the data available since

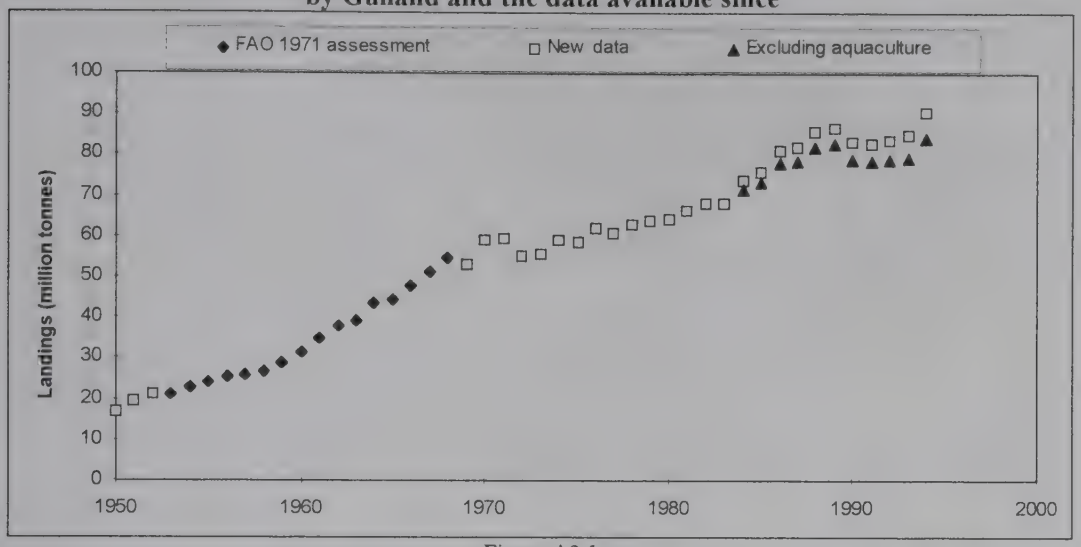

Figure A2.1

Summarised here are two aspects of a recent study[3] of fishery development trends and fisheries potential based on the analysis of FAO landing statistics for the period 1950-1994 detailed by species and major fishing area, about double the extension of the series of data which was available to Gulland.

Trends in fishery development

The process of development of a fishery as described by changes in landings with time has been described by many authors (e.g. Caddy and Gulland[4], Caddy[5]). This process is schematically represented in Figure A2.2 as comprising four phases: (I) undeveloped, (II) developing, (III) mature, and (IV) senescent. The Figure shows the theoretical change in yield and relative rate of increase of yield during the development process. The relative rate of increase, which varies significantly as the maximum long-term yield is approached, reached and "overshot", is of particular interest and has been used here to provide a rough assessment of the state of marine resources, globally and by ocean. This rate is nil for a stable non-developing fishery (phase I), but increases rapidly (phases I-II) as the fishery starts to develop. It then decreases during the phase of steady growth of the fishery (phase II) and drops to zero again when the fishery reaches its maximum production (phase III). In reality, this representation is of course obscured by natural fluctuations as well as by noise in the data. However, the trend in decline of the relative rate of increase during phases II and III was used here to estimate when full potential has been reached and what the corresponding potential multispecies yield could be.

It is important to note, however, that aggregate landings from various stocks which are the subject of a fishery-complex may continue to increase despite local overfishing situations as long as the process of increase through expansion to new areas and resource elements overshadows the process of decrease through overfishing. An important implication is that the highest landings observed in a "mature fishery" represent a sort of multi-species composite

average long-term yield (ALTY) which is different from the sum of the theoretical maximum sustainable yields (MSYs) for the various resource elements, whether these elements represent different species in a given area or even different areas with their multispecies resources components in a given region or ocean.

The top 200 species-area combinations for marine fish, referred to here as "resources", were selected for analysis on the basis of average landings over the whole time period. These 200 major resources, which account for 77% of world marine fish production, were grouped by cluster analysis, according to the shape of the landing trends, irrespective of the scale of the landings. Twelve resource groups were defined, and for each of these an average landings trend curve was described. These curves can be considered as comprising parts of the overall fishery development model described above and reflecting some of the various phases identified (from I to IV, from undeveloped to senescent). Each curve was divided into segments corresponding to different phases of the generalised model (Figure A2.2) and the number of resources in each phase of fishery development calculated for each year. The overall pattern of change in the phase composition is shown in Figure A2.3.

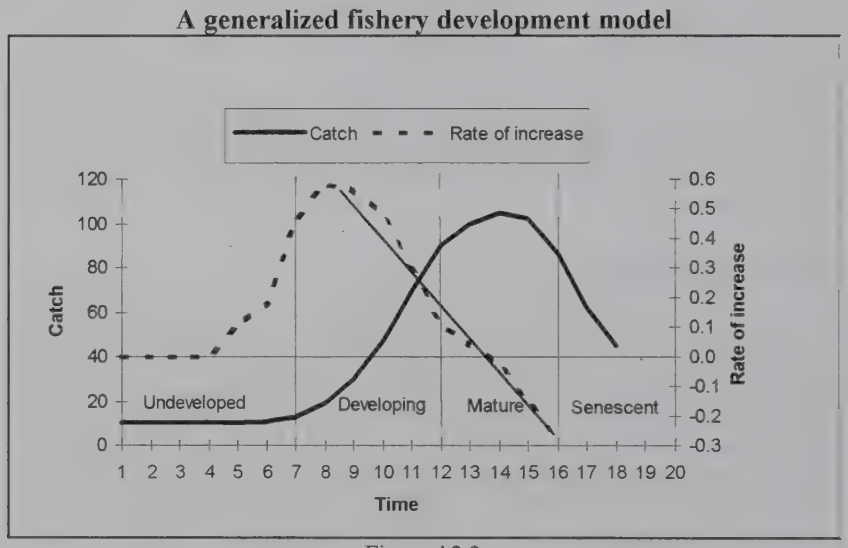

Figure A2.2

This figure strikingly illustrates the process of intensification of fisheries since 1950 and the increase in the proportion of world resources which are subject to declines in productivity ("senescent", phase IV). It also underlines the fact that the ever-growing total tonnage of world fishery production gives a misleading vision of the state of world fishery resources and a false sense of security (a comment already made by FAO[6]). Unfortunately, a similar comment should probably be made for changes in total aggregated landings at national level, so often used as a justification for further development.

The results shown for 1994 indicate that about 35% of the 200 major fishery resources are senescent (i.e. showing declining yields), about 25% are mature (i.e. plateauing at a high exploitation level), 40% are still "developing", and 0% remain at low exploitation (undeveloped) level. This indicates that around 60% of the major world fish resources are

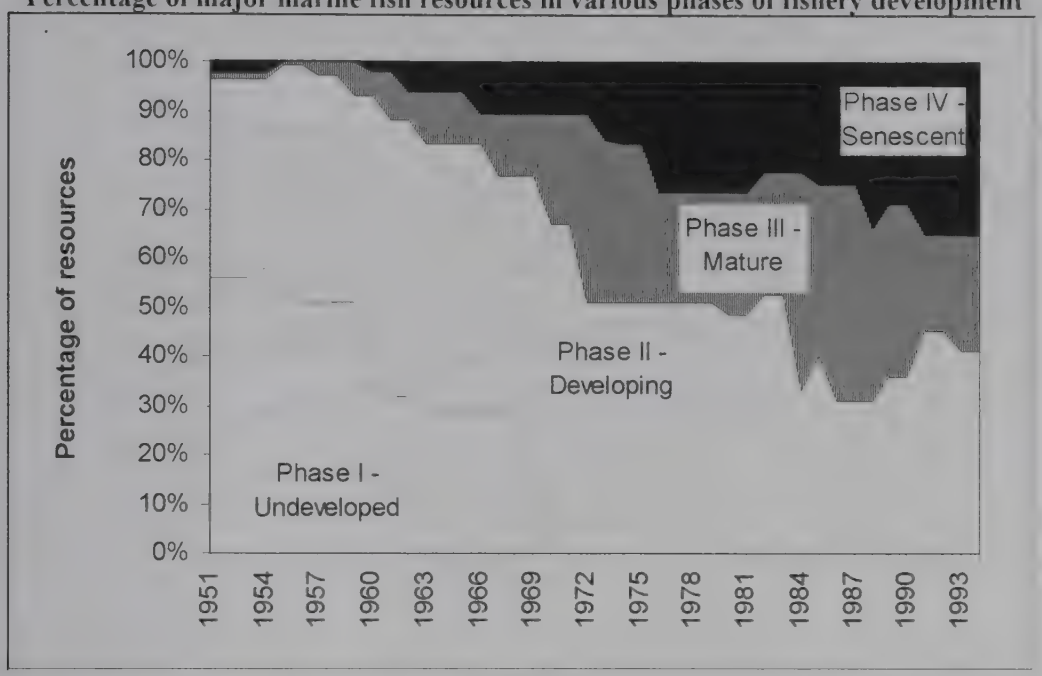

Figure A2.3

either mature or senescent and, given that few countries have established effective control of fishing capacity, these resources are in urgent need of management action to halt the increase in fishing capacity or to rehabilitate damaged resources. A strikingly similar conclusion was reached by FAO[6], which concluded that 44% of the stocks for which formal assessments were available were intensively to fully exploited, 16% were overfished, 6% depleted, and 3% slowly recovering, concluding therefore that 69% of the known stocks were in need of urgent management. That same study, using a global production model, with estimates of the world capacity, concluded that the demersal high-value species were overfished and that a reduction of at least 30% of fishing effort was required to rebuild the resources.

Potential of marine fisheries

In a review of the state of world fisheries undertaken in 1994, FAO[6] showed that the annual relative rate of increase of world reported landings had significantly decreased since 1950 and was approaching zero, indicating that the maximum production from the world's conventional marine resources under current exploitation regimes was being approached and that the mean catches of the last few years were probably very close to that maximum. The same analysis has been repeated below globally and by oceans.

Based on the analysis of total marine landings, the predicted maximum production for world marine fisheries with the present overall fishing regime (generally characterised by small sizes at first capture and significant discards) corresponds to about 82 million tonnes, a value close to the average landings of 1990-94 of about 83 million tonnes. This crude global estimate of the world potential of conventional resources under the present regime of exploitation indicates that the world would be at full potential about now. This is a composite, aggregate result, which hides the increasing occurrence of overfishing on a multitude of stocks in many

Trends in relative rate of increase in landings by ocean

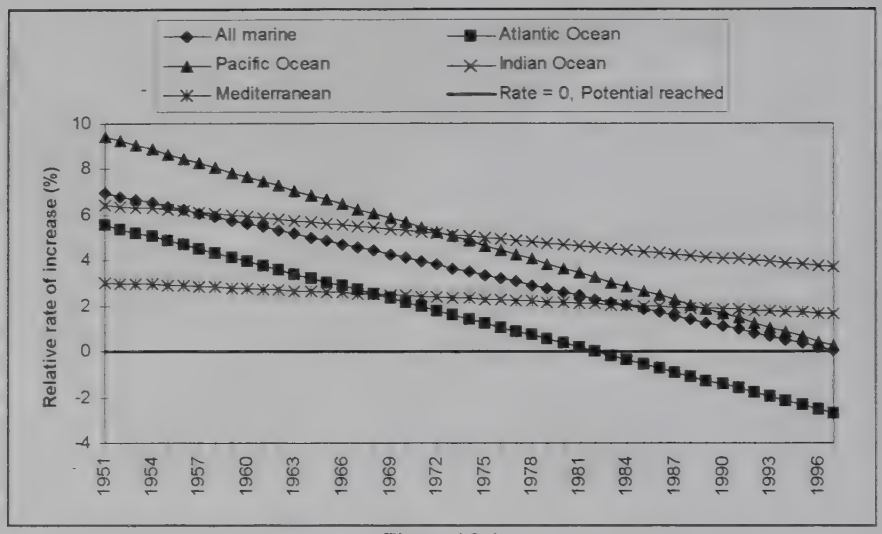

Figure A2.4

different areas, as evidenced by global statistics over the last half century. In order to reduce this effect, and illustrate differences in development rates, timing, as well as potential, the analysis has been undertaken separately for each ocean.

The time series of landings for the Atlantic, Pacific and Indian Oceans, as well as for the Mediterranean Sea (including the Black Sea) have been processed in the same way as the world marine total landings, and the corresponding lines showing the declines in relative rate of increase are shown in Figure A2.4. Only the main conclusions are reported here and details can be found elsewhere[3].

Estimates of world marine production potential were obtained from the two analyses as follows:

a) - Estimate based on world marine total landings (Potential = 82 million tonnes);
b) - Summing individual estimates made for each Ocean (Potential = 100 million tonnes).

The aggregated estimate of 82 million tonnes refers to the present fishing regime. The difference between the aggregate potential (in case *a* above) and the sum of the different oceans' potentials (in case *b* above), which amounts to 18 million tonnes, would come partly from optimisation of the production in the North Atlantic and increasing landings from the Indian Ocean. However, this latter possibility results from a rather unreliable extrapolation and should not be used as a basis for planning further development in this ocean.

In order to gain some insight as to how fishery potential might be distributed within each ocean, the same analysis was undertaken at a lower level of aggregation by considering total landing for each of the 16 FAO major fishing areas for statistical purposes. The results are summarised in Table A2.1. Taking all the results at face value, the analysis indicates an overall potential of 125 million tonnes, assuming that each area can be separately optimised. However, the statistical fits vary and in some cases are much poorer than for the analysis by

ocean. It is therefore strongly recommended that this section be read in conjunction with the regional reviews in the following section. A subjective classification of the reliability of each of the estimates of potential is given in Table A2.1.

Table A2.1: Comparison between estimated potentials and average landings of the last 5 years (1990-1994) in million tonnes

AREAS	Estimated potential (A)	Year potential reached	Subjective degree of reliability[1]	Landings 1990-94 (B)	Difference (A-B)	Status[2]
E.C. Atlantic	4	1984	**	3	1	O
N.E. Atlantic	12	1983	*	10	2	O
N.W. Atlantic	4	1971	**	3	1	O
S.E. Atlantic	3	1978	**	1	2	O
S.W. Atlantic	1	1997	Unreliable	2	-1	I
W.C. Atlantic	2	1987	*	2	0	O
E. Indian	10	2037	Unreliable	3	7	I
W. Indian	13	2051	Unreliable	4	9	I
Med. & B.Sea	2[3]	?	Unreliable	2	0	F
E.C. Pacific	3	1988	**	1	1	O
N.E. Pacific	4	1990	*	3	1	O
N.W. Pacific	26	1998	**	24	2	I
S.E. Pacific	29	2001	*	15	14	I
S.W. Pacific	1	1991	**	1	0	O
W.C. Pacific	11	2003	**	8	3	I
Antarctica	0.2	1980	**	0.3	0.1	O
SUM OF AREAS	125			83	42	
Atlantic Total	21	1983	**	21	0	I-F
Pacific Total	54	1999	**	53	1	I-F
Indian Total	23[4]	?	Unreliable	7	16	I
Med. & B.Sea	2[3]	?	Unreliable	2	0	F
SUM OF OCEANS	100			83	17	
WORLD	82	1999	**	83	-1	

[1] ** Reasonably reliable regression, * Less reliable regression, Unreliable regression
[2]Overfished, Increasing, Fully fished (based on date when rate of increase = zero)
[3]Increase probably due to eutrophication, potential assumed equal to present production
[4]Sum of the separate estimates for the Eastern and Western Indian Ocean

The most reliable estimates (marked as ** in Table A2.1) yielded by the above analysis would indicate that an increase of 10 million tonnes from recent landings of about 83 million tonnes could well be possible (i.e. leading to a possible total potential world marine production of 93 million tonnes), including 4 million tonnes coming from improved management of overfished stocks in each of the Atlantic and Pacific Oceans and 2 million tonnes from fisheries development in the Indian Ocean.

If less reliable estimates (marked * in Table A2.1) are taken into account, an additional increase of 17 million tonnes (i.e. leading to a possible total potential world marine production of 110 million tonnes) might be possible, comprising 2 and 1 million tonnes from management of overfished stocks in the Atlantic and Pacific Oceans respectively and 14 million tonnes from development in the Pacific Ocean. However, this further possible increase is more problematic.

Further, taking into account the least reliable estimates would lead to an additional increase of 15 million tonnes from fisheries development in the Indian Ocean, leading to a total potential world marine production of 125 million tonnes. This perspective remains, however, highly uncertain. These hypothetical potential increases, particularly the last two, corresponding to total production of 110 and 125 million tonnes, have to be considered with prudence because some critical regional assessments (i.e. Indian Ocean, Mediterranean and Southeast Pacific) are not reliable and require further analyses to confirm or reject the preliminary results given above.

The analysis predicted that full potential for the Indian Ocean had not been reached and will not be so for decades (Figure A2.4), and the estimate of potential should be considered very unreliable until further substantiated. Generally speaking, the Indian Ocean has an important biological potential but its coastal resources are under severe stress in many areas and require effective management, even though potential for expansion may exist further offshore. The scarcity of stock assessment work in the area makes it difficult to confirm or reject the result of this preliminary analysis. It must also be pointed out that, although the possibility of expanding Indian Ocean fisheries offshore and into deeper grounds has been repeatedly considered by some coastal countries in that area, particularly India, Indonesia, Malaysia and Thailand, no convincing evidence of high additional levels of resources has been provided yet (except perhaps for tropical tunas and tuna-like species).

It is interesting to note that the estimates of the possible gains to be obtained through management or development depend on the level of aggregation in the analysis. The more aggregated the data used for the analyses, the less is the estimated potential for further increase. This is an expected result, as only a disaggregation of the time series by region and stock can reveal the various situations of under-development or overfishing that exist simultaneously in all areas. This analysis of regional resources takes the disaggregation only some way towards the stock level of detail. It is also worth noting that the potential estimated at the ocean level of aggregation (100 million tonnes) lies between the potentials estimated from the analysis by major fishing area utilising only those estimates considered reasonably reliable (93 million tonnes) and those considered reasonably reliable and less reliable (110 million tonnes).

Implications for management and development

For the resources which are presently below their historical peak levels of production, it might be possible to return to these levels by reducing fishing effort and, in most cases, simultaneously improving yield-per-recruit. This can be achieved by increasing significantly the age at first capture, prohibiting the exploitation of juveniles, increasing mesh sizes, and closing temporarily or permanently areas of concentrations of young fish. Examples in Cyprus and the Philippines[7] have shown that increases of sustainable production of 100% can be obtained in the tropics within 18 months. More recent experiences with the protection of juveniles in Morocco (on cephalopods, through a closed season-area) and Norway (on cod, through *ad-hoc* area closures) have also produced improvements in catch rates which tend to show that short-term benefits can also be expected in more temperate areas. Effective management can undoubtedly also lead to long-term increases in yield. This has been demonstrated for the Northeast Arctic cod stock in the Norwegian and Barents Seas which, in contrast to most other Atlantic cod stocks, has shown a recovery in spawning stock biomass from a depleted

condition to a level not seen since the 1950s following a major reduction in fishing mortality in the late 1980s[8].

An important problem and opportunity is in the potential improvement from the reduction of unwanted bycatch. It has been estimated that between 18 and 39 million tonnes of fish are discarded every year[9] (average = 27 million tonnes), comprising of species of low commercial value but also of a large proportion of juveniles. These are part of the catches, if not part of the landings and are not included in the data used in this study, but nevertheless need to be taken into account for management. If added to the recent landings, they result in a world marine catch of about 101 to 122 million tonnes (average 110 million tonnes). The benefits resulting from a reduction of unwanted bycatch through increased survival of juvenile fish can be very significant.

Increases in production would come from further fisheries expansion on those resources which are apparently still increasing their contribution to world landings (about 40% of major fish resources are classified as still "developing" in this study and FAO in 1994[6] estimated 32%). It must be recognised that even though for these resources landings are still growing at a steady rate, it is not possible to have a reliable estimate of the potential. It would be a mistake, however, not to recognise that some potential exists.

An important question is whether, at the global level at which the analysis has been conducted, improvements in yield from both demersal predators and pelagic prey can be expected. The pelagic group contains a number of significant predators, among which are the large pelagic tunas and tuna-like species. The eggs and larvae of many demersal species, and the adults of some small demersal fish, are prey for the small pelagic species. Similarly, small pelagics are often major dietary components for larger demersal fish. The implications of these interactions are not easy to foresee and it is therefore impossible to establish how much of the present balance in the abundance (and potential) of pelagics and demersals results from the relative overfishing of the demersals and the resultant reduced pressure on pelagics. Neither is it possible to determine to what extent the rehabilitation of the overfished demersals will affect the survival and potential of the pelagics. The issue of resource rehabilitation at large regional scale has never been tackled and remains, with the issue of the medium-term variations of the small pelagics, one of the key issues of the management of fisheries for the 21st century.

In conclusion, while it must be recognised that the statistical significance of most of the analysis described here is insufficient, the elements of information available indicate that an increase in fisheries production of at least 10 million tonnes is possible plus further increases in landings of an unknown magnitude obtained from fisheries development as well as from mariculture. FAO in 1995[10] indicated that an additional 20 million tonnes more of landings might be obtainable. The results of the present study provide a firmer basis for believing that such an increase can be realised if: (a) degraded resources are rehabilitated, (2) under-developed resources are exploited further, avoiding, however, their overfishing and avoiding the overfishing, of those resources which have already reached the highest level of sustainable exploitation they can with stand, and (3) discarding and wastage are reduced.

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B. REGIONAL REVIEWS

1. NORTHWEST ATLANTIC

FAO Statistical Area 21

INTRODUCTION

Figure B1.1

This cold-water area has been an important area for commercial fisheries from as early as the 1500s. Coastal fisheries (Figure B1.1) occur in a marine regime dominated by the cold-water Baffin Current which moves southward next to the shore. Offshore warmers waters brought north by the Gulf Stream are found. Three shallow water areas (the Grand Banks, the Scotian Shelf and George's Bank) have traditionally been the source of most of the rich demersal fisheries of the region. Other smaller shelf areas include Hamilton Bank (important for cod fisheries in the 1970s and 1990s), the Flemish Cap (important for redfish fisheries) and the southern region of the Gulf of St. Lawrence. The "nose and tail" of the Grand Banks lie outside the Canadian EEZ in international waters as does the Flemish Cap.

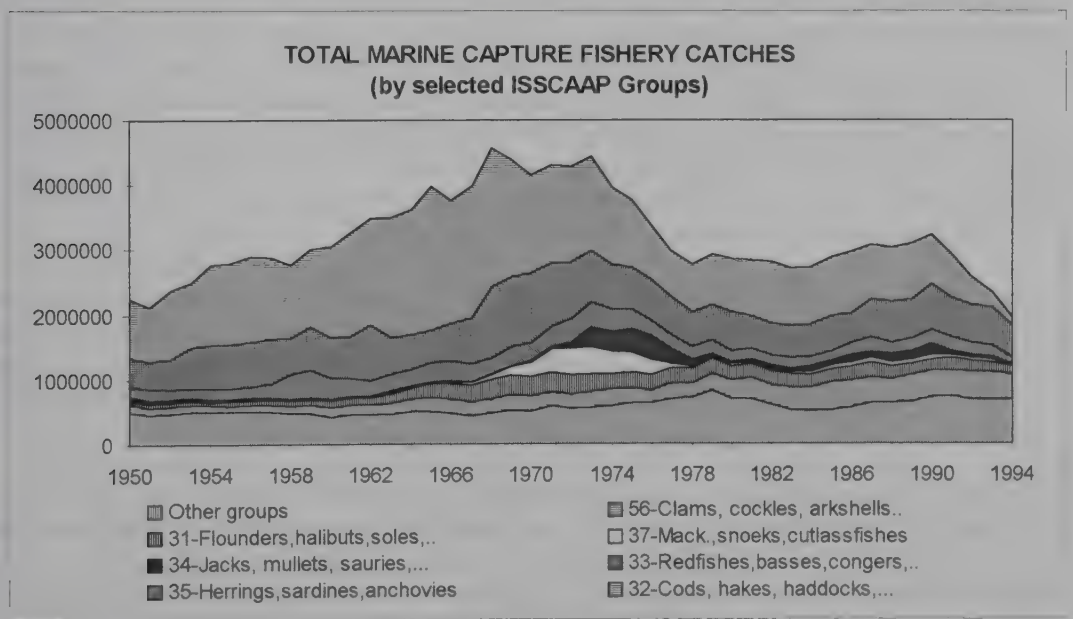


Figure B1.2

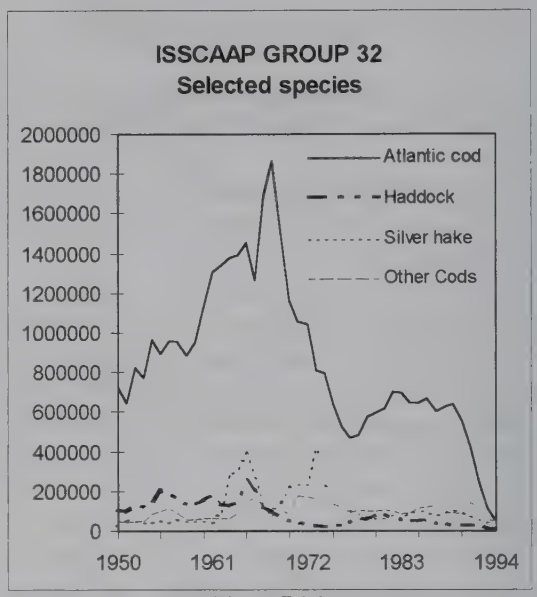


Figure B1.3

Although some stocks, particularly invertebrates such as lobster and scallop, are at levels which can be considered healthy, the general situation of the demersal stocks that were the dominant resources of the past continues to be discouraging. In the northern area (Labrador and the Grand Banks) there are demersal stock collapses caused by heavy fishing and environmental effects, mainly the low water temperature of the Labrador current. During 1995 many traditional demersal fisheries remained closed or operated on reduced quotas due to the depressed stock biomasses. Prospects are improving for haddock and flatfish on the Scotian Shelf and, while stocks of demersal fish are low, the condition of individual fish appears to be improving. US surveys report record highs for the coastal stock complex of herring, and herring larval surveys indicate abundance of about 50% of the peaks observed during 1973-74. Landings or pelagic species are slightly below recent historic levels and while landings of invertebrates are declining they continue to contribute the greatest value to NW Atlantic fisheries. Dogfish, a relatively recent arrival, continue to dominate the demersal biomass in the southern areas.

PROFILE OF CATCHES

Peak landings in Area 21 occurred during the late 1960s, with an average of 4.0 million tonnes per year during this decade. Landings declined to 3.3 million tonnes in 1990 and yet further to 2.0 million tonnes in 1994 (Figure B1.2 and Table I). The peak in the late 1960s can be seen as principally due to large landings of species in ISSCAAP Groups 32 and 35. Although reported catches of herrings of ISSCAAP Group 35 have declined considerably from this earlier peak, herring is now the dominant group. This is largely due to the catastrophic decline in catches of ISSCAAP Group 32 species. The high total catches of the late 1960s were sustained into the early 1970s by increasing catches of mackerels, redfishes and jacks (ISSCAAP Groups 37, 33 and 34 respectively).

By the late 1970s catches of species in these three ISSCAAP Groups had declined. During the 1980s and 1990s the clams and cockles of ISSCAAP Group 56 became more significant, and catches of these species are now second only to the herrings. Catches of species in another mollusc group, the scallops of ISSCAAP Group 55, are now the third largest ISSCAAP Group.

Figure B1.3 shows the trends in reported landings of gadoids and highlights the decline that has occurred in this important group. The most important member of this group has been cod (*Gadus morhua*). Reported landings of this species literally peaked in 1968 at ~1 866 000 t and then fell steeply to ~482 000 t in 1978. There was a subsequent recovery during the

period 1982 to 1989, followed by the collapse to the point of closure of the fisheries in Canada, essentially still the situation in Canada today.

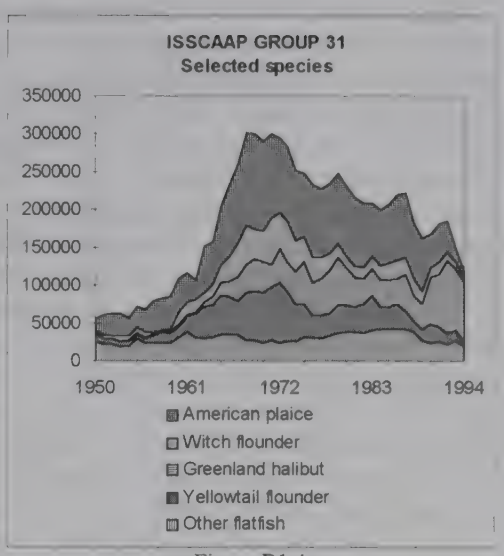


Figure B1.4

The decline in landings of cod has been progressively greater in the northern part of its range (i.e. Labrador, The Grand Banks, Scotian Shelf and Gulf of St. Lawrence). In 1989, when landings were at a level of 639 936 t, landings by the US, which would mainly be from their EEZ, were 5.6% of the total. In the following years, this percentage increased from 7.8% to 36.2% as ocean cooling and subsequent stock closures took effect and landings fell to 48 477 t in 1994.

Declines have also been recorded for haddock, a gadoid of importance in the more inshore fisheries. Changes in landings of silver hake have largely reflected the result of fishing agreements reached between the Cuban and Canadian Governments, though catches of this species were also taken by eastern European fleets in the past. The flatfish and redfish (species Groups 31 and 33 respectively) are other demersal groups showing a decline corresponding to that of cod (Figure B1.4 and Table I). Shrimps are now the fourth most important group landed (i.e. pink shrimps, Figure B1.5), whereas in the past the catches of these crustaceans had been insignificant relative to the enormous catches of cod. Lobster, in contrast, have shown an increase that, while not as important as that of shrimp, is still noteworthy.

The smaller pelagic species (Figure B1.6) are another group that has shown large variations in landings. Herring, still important, reached nearly a million tonnes of landings in 1968 and 1969 (Table I) as foreign fleets, primarily eastern European vessels, targeted stocks on Georges Bank. However, a decade later reported landings were down to 252 949 t and continued to decline, a consequence of falling stocks and reduced demand as North Sea herring stocks recovered and the western Atlantic stock, with its higher oil content, lost market share. Since the adoption of extended fisheries jurisdiction (EFJ) the catches of Atlantic mackerel have also been affected by the exclusion of distant water fishing nations (DWFNs) from the EEZs of Canada and the USA Peak landings (420 500 t) were reported in 1973 while catches in the 1990s have ranged from 65 467 t in 1990 to 27 685 t in 1994. Capelin too show a similar trend, the consequence of varying effort by DWFNs. In 1972 272 400 t were landed, compared with 2 242 t in 1994.

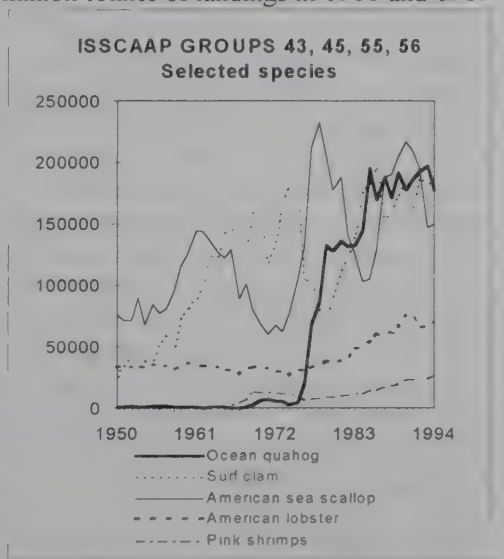


Figure B1.5

While important pelagic and demersal resources have been declining, molluscan catches (Figure B1.5) have expanded dramatically as new resources have been exploited in response to availability of markets, both for domestic and export markets. While ocean quahog had always been harvested in small quantities prior to 1976 (reported landings had not exceeded 4 700 t), after 1976 catches went up steadily to 195 793 t in 1985 and stayed above 169 732 t in subsequent years. Surf clam and American scallop are the other important shellfish in this group.

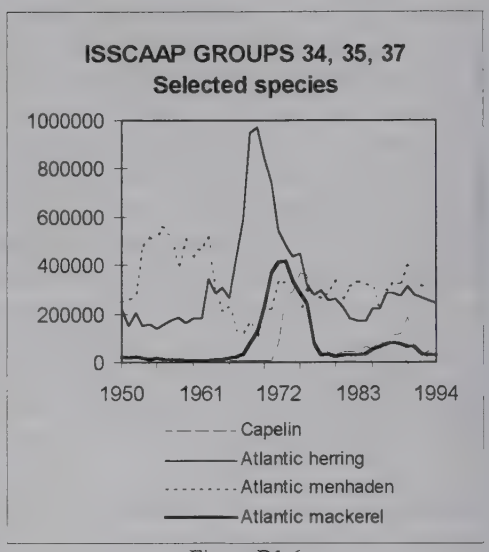


Figure B1.6

Prior to the introduction of EFJ in 1977 catches by distant water fishing fleets made up nearly half of the total catches taken in the Northwest Atlantic. The majority of the catches in several Northwest Atlantic fisheries were taken by distant water fishing fleets (i.e. in the 1970s, Canadian catches of cod constituted only 26% of the total). The development of these distant-water fisheries in the Northwest Atlantic occupies a central role in the history of Europe from at least the 15th century. Peak landings by foreign vessels were in 1973 with reported catches of 2 453 093 t. It is only in the last few years with the advent of extended jurisdiction that these centuries old fisheries have almost stopped. By the 1980s the DWFNs (all nations except Canada, Greenland, St. Pierre and Miquelon and the USA) share of the catch had declined to 12%.

The decline of the groundfish fisheries has seen the DWFN's share drop further in the 1990s, to only 6.8% of the catch in 1994 (39.9% of this foreign catch was taken by Spain, 22.2% by Portugal, 9.1% by Cuba and 8.7% by Norway, with ten countries sharing the remainder). Of the species taken, 43.2% were various flat fish (of which Greenland halibut was the most important), 15.4% were shrimp (mainly *Pandulus borealis* taken in Davis Strait), 14.0% various gadoids and 14.0% redfish (both taken on Flemish Cap and the nose and tail of the Grand Bank) and 8.9% sharks (taken mainly by longline).

Following the exclusion of the DWFN fleets, several stocks showed signs of recovery. However, as the historical profile of landings reveals, these resurgences were short-lived. The programme of fisheries nationalization undertaken by both the USA and Canada resulted in rapidly increasing levels of national fishing effort. The Canadian share of total catches of ISSCAAP Group 32 (cods, hakes, haddocks etc.) jumped from 26% in the 1970s to 64% in the 1980s. The recent trends in resources within the EEZs of Canada, the USA and Greenland are discussed further in the description of the status of selected resources.

Despite the dominance of USA and Canadian catches in the Northwest Atlantic, the catches by Greenland and St. Pierre and Miquelon are of interest. The fisheries of Greenland occur at the margin of the range for cod and depend on climatic fluctuations. Cooling results in a decline of catches; warming causes a contrary trend. This effect has been traced back to the Viking habitation of Greenland. Catches by Greenland increased five-fold between 1950 and 1990 (from ~27 000 t to ~133 000 t), during which time the species composition of the catch shifted from being almost entirely cod to being half cod, half shrimp. By 1994, while shrimp landings

had continued to grow (to 75 908 t), landings of cod had collapsed to 3 971 t, - 6.7% drop in landings in 1990. Also of international interest has been the decline in salmon landings from 1 433 t/yr during the 1970s to 23 t in 1994. This decline in landings of salmon by Greenland demonstrates how effective agreements have been in reducing 'intercepted' catches of this anadromous species, under threat in many of the countries in which it spawns.

The fisheries of St. Pierre and Miquelon owed their existence to rights with Canada for cod fisheries within the Gulf of St. Lawrence. These became territorial waters when Canada implemented a closing line between Newfoundland and Nova Scotia. A subsequent World Court Ruling restricted the territorial waters of these French Islands to a coastal region and a narrow 200-mile-wide coastal strip extending southwards and enclosed by Canadian waters on both sides. The collapse in landings by St. Pierre and Miquelon is the result of the general stock collapse in the area and the loss of fishing privileges (though as recently as 1990 and 1991 landings of 19 138 and 19 164 t were reported). By 1993 catches were down to 155 t with a slight recovery to 272 t in 1994, though still negligible in historical terms. Redfish, previously a minor species, is now the dominant species landed.

In addition to fisheries for the marine fish and invertebrate species described above, fisheries for seals in this region have existed since the early 1700s and have been an important part of the economic and social history of Eastern Canada, particularly in the poorer regions of Newfoundland. The major fishery has been on the harp fishery at pupping time when seal pups were harvested primarily for their white coats and secondarily for their meat. A ban on the use of seal products in the EC following effective protests by animal protection societies caused the markets for the seal skins to collapse. Additionally, as a consequence of the negative publicity, the Canadian Government closed the fishery for pups. The role of seals as competitors with man for fish remains disputed.

RESOURCE STATUS AND MANAGEMENT

Following the introduction of EFJs in 1977 the majority of the marine resources of the Northwest Atlantic came within the EEZ's of Canada and the USA (with minor resources in the EEZ's of Greenland and St. Pierre and Miquelon, as noted above). As evident from the downward trend in landings, stocks of the once most important gadoids are near their lowest levels ever. This appears to be the consequence of two phenomena: excess fishing pressure and cooling of ocean temperatures. In Canada, several formerly major fisheries have been closed, while in the United States management efforts are still struggling to implement schemes for effective reduction of fishing effort.

Canada

The history of the fisheries on the Grand Bank and other shelf areas of Canada pre-date the European exploration and Settlement of that area. When Jacques Cartier voyaged into the Gulf of Saint Lawrence for the 'first time' he had already encountered European vessels fishing in the area. For several centuries the history of the fisheries of this area was the history of salt cod, usually caught by line from small vessels. The switch to trawler technology has been mainly a transformation of the last generation. The event of greatest importance in recent years has been the extension of jurisdiction by Canada over fish stocks within the 200nm limit. With this extension much optimism existed that national catches would increase considerably

through better resource management. This has not been the case, and large infusions of 'transfer payments' were needed to achieve Federal Government social objectives.

The downturn of the northern cod fisheries in the last decade has been widely documented, and debate continues with regard to the relative importance of 'overfishing' and environmental effects. No doubt, both have been factors in the virtual commercial extinction of the cod fisheries, one of the most famous and historical in the world. There has been some evidence that 4-5 year old cod are spawning in some areas, but it is accepted that it is still too early to consider unrestricted opening of the fishery. The collapse of groundfish stocks has not been restricted to the more northern Newfoundland grounds but has extended to the Gulf of St. Lawrence and Scotian Shelf.

A key issue in Canadian waters remains the strategy for recovery of these northern cod stocks. The fisheries continue to remain closed at great social and economic cost and, though there have been some signs of recovery in limited areas, stock levels are nowhere near those required for reopening fisheries. Concern continues with the applicability of one of the main methods of stock assessment, virtual population analysis (VPA). Retrospective analyses show that this method continues to be too optimistic in terms of stock sizes and that, as more data become available, year class strengths are inevitably reduced - though of course, this is after the quotas set have been fished for the years in question.

The 1996 wazzu assessments include closures of 11 demersal stocks which will allow these stocks to benefit from the less harsh ocean conditions. Further, some southerly stocks are showing indications of recovery. Encouraging signs have been evident for haddock stocks on parts of the Scotian Shelf and there has been improved recruitment of flatfish. Despite this, it will take between 5 and 10 years for year classes to mature after recruitment. While a single successful year class may be sufficient to rebuild depressed redfish stocks, several successful year classes will be necessary to rebuild the spawning stock biomasses of cod, flatfish and white hake. For these stocks it will take 7 to 12 years from the time of successful recruitment to rehabilitation of the fishery.

Not all fish stocks are in a distressed situation. Lobsters, an extremely valuable species, continue to be landed near their record high levels and, because of strong market demand, the fishermen have been earning more than ever. As in many other areas the expansion of fisheries for non-traditional species is providing alternative opportunities for fishermen whose traditional resources are either fully or over-exploited. In Canada, these include fisheries for snow crab, toad crab, sea urchins, northern shrimp and Arctic surf calm.

In the Gulf of St. Lawrence the grey seal population is growing at a rate of about 8% per year; outside of the Gulf, on Seal Island, the population is growing at a rate of 12.6%/yr. Estimates of harp seals depend on determining the number of pups and then extrapolating the size of the adult population. During the 1970s estimates of pup production ranged between 250 000 and 500 000. In 1990, pup production was estimated to be 580 000 ± 13%, while in 1994 production was estimated at 703 000 ± 18%. Total harp seal population size in 1994 was estimated to be 4.1 million animals. A replacement yield (i.e. number that could be harvested without changing the total population) is estimated to be 287 000 animals. Total prey consumption by harp seals was estimated to be 6.9 million tonnes in 1994. Of this, 46% was from Arctic waters, 40% from Eastern Newfoundland and 14% from the Gulf of St. Lawrence. Most of their prey is Arctic cod, a non-commercial species; but an estimated 620 000 t of

capelin were also consumed. Atlantic cod is a relatively small part of their diet though, despite this, it is estimated that harp seals would have consumed approximately 88 000 t of this species in 1994. In the Gulf of St. Lawrence, consumption of cod by harp seals was estimated to be around 54 000 t. The majority of fish eaten by these seals are young, 10-20 cm in length. It is realized that the assumptions used in these estimates may change as scientific knowledge about the bio-energetics and prey of these animals improves.

United States

The fisheries of the northeast USA have a long tradition, based on the highly productive demersal resources of Georges Bank and, to a lesser extent, the famous lobster fisheries of the Gulf of Maine. Other significant fisheries have been for scallop and flat fish. A variety of fishing gear are used but the "dragger" trawler has become the dominant type of fishing. In the 1970s and early 1980s a large foreign fishery, primarily of eastern European factory trawlers, was directed at resources on the Georges Bank starting a trend of resource depletion that has still not been reversed. Herring were fished to commercial extinction, and ground fish stocks are today at, or near, their lowest levels ever. Management is hard pressed to implement conservation measures that are acceptable to the industry.

Small pelagic species have also been important, particularly herring on Georges Bank and the Gulf of Maine, and menhaden, a large clupeoid with a migratory range along the Atlantic Sea Board. Other small pelagics harvested include Atlantic mackerel, butterfish and short and long-finned squid. These fisheries are seasonal as these species over-winter in the relatively warm offshore waters of the Mid-Atlantic continental shelf and southward to avoid the cooled waters of the north; inshore migrations for feeding occur in the spring and summer. Atlantic mackerel and herring were heavily exploited by distant-water fleets during the 1970s with a concomitant decrease in their abundance.

Species occupying, at least for some part of their life cycle, estuarine of freshwater habitats also appear to be under extreme stress. In New England, these are primarily menhaden (*Brevoortia tyrannus*) and shad (*Alosa pseudoharengus*). USA landings of alewife in 1994 were 0.6% of those for the average throughout the 1950s; those for bluefish in 1994 were 58.2% of those for the 1950s and those for shad were 13.8%.

The status of stocks in the USA are classified according to the current level of abundance relative to the long-term potential yield (LTPY). These data show that the Recent Annual Yield (RAY) for the northeast demersal and pelagic groups are significantly below their LTPY, being 36.3% and 45.5% respectively. RAY for Atlantic anadromous species are in line with their LTPYs:

Unit/Fishery (in tonnes)	Entire Range of Stock			Prorated within USA's EEZ	
	Total RAY	Total CPY	Total LTPY	USA RAY	USA LTPY
Northeast demersals	185 535	183 735	479 335	145 900	402 365
Northeast pelagics	165 800	724 300	412 000	115 600	253 920
Atlantic anadromous	4 836	4 836	4 836	4 836	4 836
Northeast invertebrates	99 500	99 900	72 500	93 568	89 357
TOTAL	455 671	1 012 771	968 671	359 904	750 478

The status of the resources in terms of their relative level of exploitation is summarized as follows:

Species/ Stock Unit	Stock status		
	Under Exploited	Fully Exploited	Over Exploited
Groundfish and flounders	1	1	10
Skates and dogfish	1	1	0
Other finfish	1	2	8
Pelagic fish	3	1	0
Squid	1	1	0
Total	7	6	18

As demersal fisheries in the Northeast occur in mixed species aggregations, this results in significant bycatch interactions in directed fisheries for specific target species. This complicates management, and this is reflected in the complex regulations governing mesh sizes, gear types, seasonal openings and closures, as set by the relevant management agencies (e.g. the New England and Mid-Atlantic Fisheries Management Councils and, in the case of stocks shared with Canada, the Canadian government). Management of these resources has been through indirect methods such as mesh-size regulation, minimum lengths for landed fish and some area closures. There are no direct controls on fishing mortality but an effort reduction programme has been started. It is acknowledged that there has been consistent overfishing of the resource.

Pelagic fisheries in the northeast are regulated through two plans developed by the Mid-Atlantic Fisheries Management Council (one for squid, mackerel and butterfish, and the second for bluefish) and a third by the ASM Fisheries Committee for Atlantic Sea Herring. The long-term population trends for mackerel and herring have fluctuated considerably during the last 25 years, reaching minimal levels in the mid-to-late 1970s, a consequence of the marked declines for both species and collapse of the Georges Bank herring. Measurements of stock abundance of the pelagic resources are relatively imprecise because of the highly variable results possible from trawl surveys which are used for calibrating cohort analysis models. This problem is compounded by the short life span of squid (annuals) and butterfish and the current low rates of exploitation of mackerel and herring because of low market demand.

Greenland

Shrimp have become the most important resource for Greenland and the Davis Strait area. In the northern part of the fishing area (NAFO Area 1B) catch rates showed a significant decrease from 1987 to 1989, were relative stable from 1989 to 1993 and then decreased further from 1993 to 1994. In division 1CD there was an increase from 1987 to 1988 and fluctuations with a decreasing trend from 1988 to 1994. The strength of recently recruiting year classes indicates that there will be some increase in stock size, although recruitment is far less than the 1985 year class that maintained the fishery's relatively high catch rates from 1990 to 1994.

Redfishes, which in this area are mainly those of *Sebastes marinus*, have shown a trend in landings that parallels those of the gadoids. Annual average landings peaked at 303 633 t/yr during the 1960s, then declined to 233 797 t in 1993, recovering slightly to 129 530 t in 1994.

2. NORTHEAST ATLANTIC

FAO Statistical Area 27

INTRODUCTION

The North Atlantic features a large subpolar gyre that plays a central role in the distribution and ecology of fish stocks in the Northeast Atlantic area (Figure B2.1). The presence of this subpolar gyre was illustrated by the "Great Salinity Anomaly", when a huge volume of cold, low salinity water travelled around the gyre from 1968 to 1981. Fish stocks in its path experienced poor recruitment, possibly due to reduced food supply and the colder temperature of the anomalous delayed primary production blooms. Other oceanographic features of the Northeast Atlantic include the extended shelf area off Northern Europe, the semi-enclosed Baltic Sea, and summer upwellings off the coast of Spain and Portugal.

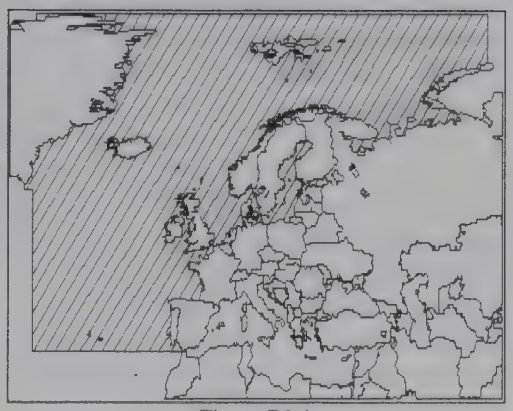


Figure B2.1

Most of the traditional fishery resources of the Northeast Atlantic are fully or overexploited, with several stocks in a depleted condition. The collapse of the North Sea herring stock for the second time in the last twenty years, and the resulting advise of 50% reduction in fishing mortality, has received much attention, although reductions of up to 40% have been advised for other stocks. The root cause of this poor situation within European waters has been the inability of the member states within the European Union (EU) to control and reduce fleet capacity within the Common Fisheries Policy. The EU Commission called for cuts of up to 40% in the size of certain fleets to be included as part of the Fourth Multi-Annual Guidance Programme (that is scheduled to run from 1997 to 2002).

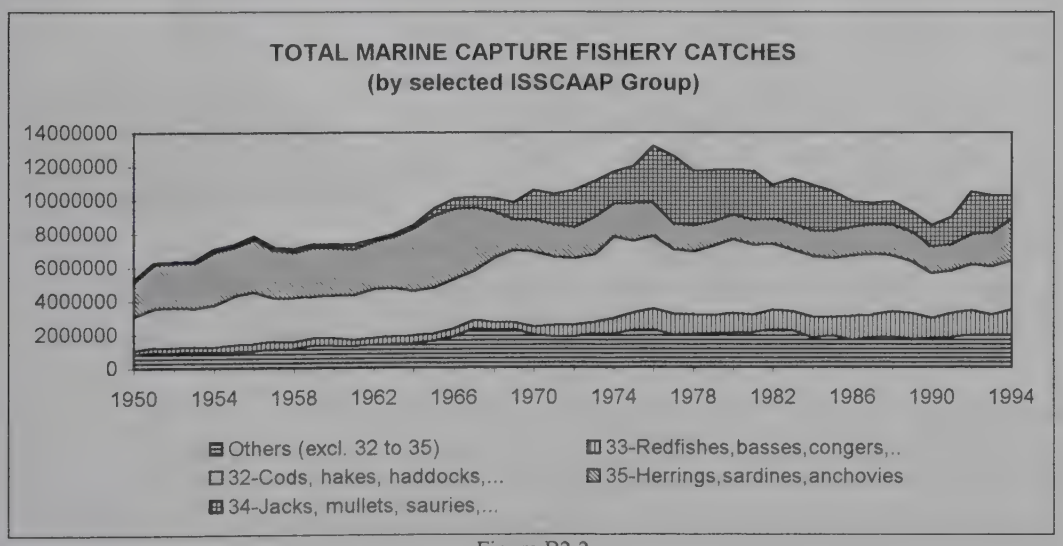


Figure B2.2

PROFILE OF CATCHES

The fisheries of the Northeast Atlantic expanded rapidly in the late 19th and early 20th century as fishing became mechanized, with short periods of relative inactivity during World Wars I and II. This expansion continued throughout the 1950s and 1960s peaking in the mid-1970s at over 13 million tonnes; since catches have declined to an average of approximately 10 million tonnes during the late 1980s and early 1990s (Figure B2.2 and Table II). The pattern of total catches masks the fact that during this period (1950 to 1994) the share of the total catch made-up by historically valuable or traditional species such as North Atlantic cod, haddock and herring has declined, while catches of many formerly lower-valued species (such as sandeels and blue whiting) have increased.

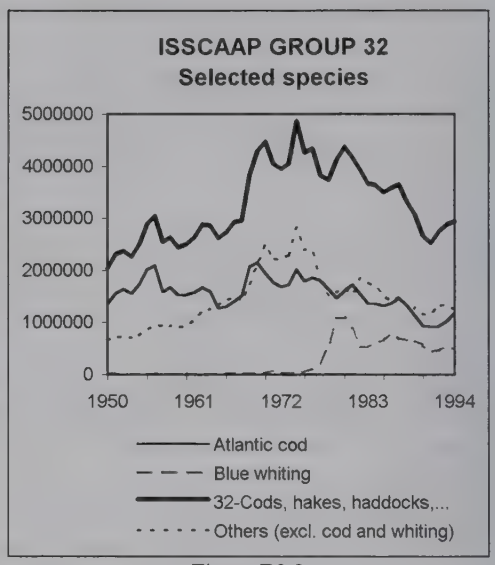


Figure B2.3

Catches of Atlantic cod have consistently made the largest contribution to the total catch of ISSCAAP Group 32 species (Figure B 2.3), although a persistent downward trend had been evident since the peak catches of the late 1960s. The later development of the blue whiting fishery delayed peak catches of this species until the late 1970s, after which a downward trend is also evident. The behaviour of the total pan-Northeast Atlantic catches of other species of ISSCAAP Group 32 has been similar, peaking in the early 1970s and then declining (Figure B2.4).

Catches of the pelagic species of ISSCAAP Groups 34, 35 and 37 are shown in Figure B2.5. Catches of Atlantic herring and capelin have shown greater short-term variability than catches of many other species, including other pelagics. This is partly due to the greater dominance of fewer stocks. For instance, the sharp decline in Atlantic herring catches around 1967-68 was caused by the collapse of the Norwegian spring-spawning herring fishery, while the low level of catches from 1974 to 1984 was caused by a decline in the North Sea herring stock (which was closed in 1977 for 4 years). Similarly, the decline in capelin catches in the mid-1980s was due to the collapse of the Barents Sea capelin fishery, which was closed from 1986 to 1991.

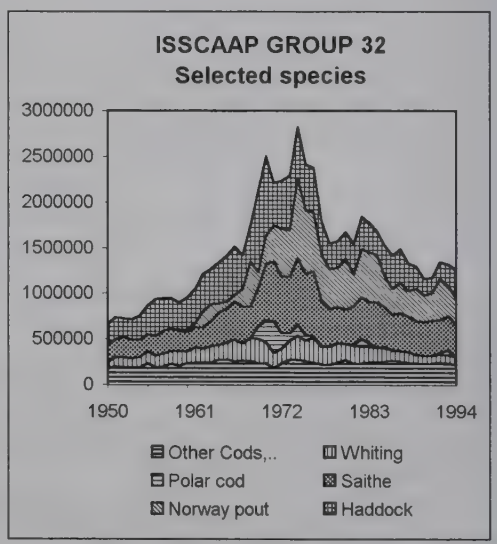


Figure B2.4

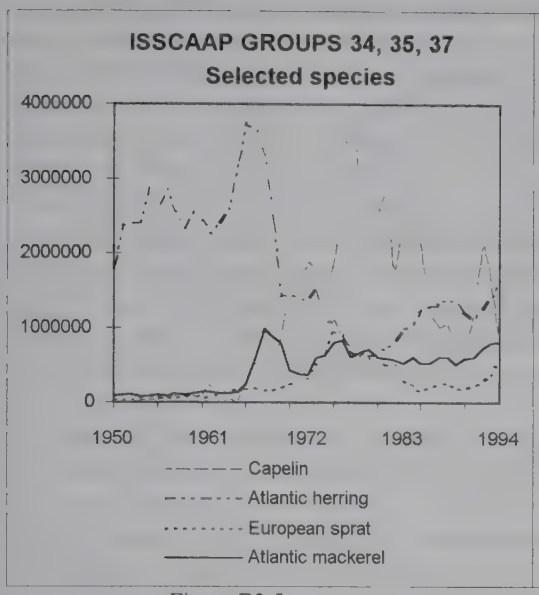


Figure B2.5

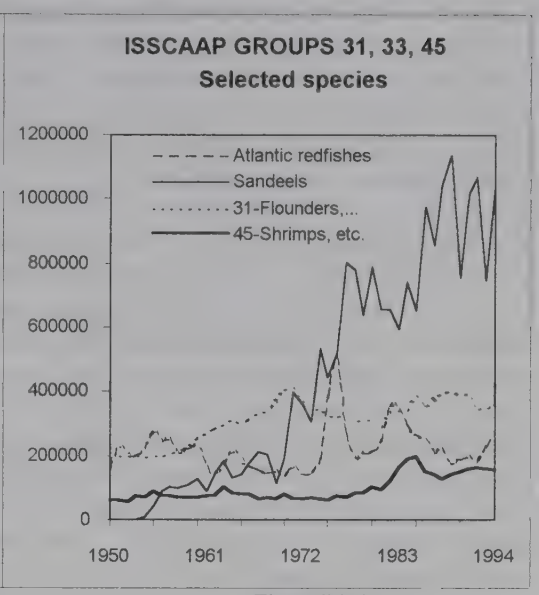


Figure B2.6

The small-mesh fishery for sandeels (in ISSCAAP Group 33) has expanded dramatically since the late 1960s but there has been no persistent trend in catches since the mid-1980s (Figure B2.6). The other ISSCAAP Group 33 species for which significant catches are taken are the Atlantic redfishes (various deep-sea and oceanic stocks of *Sebastes mentella* and *S. marinus*). Catches of shrimps (ISSCAAP Group 45) have increased since the early 1980s. This increase has come predominantly from catches of northern prawn: the combined catches of other ISSCAAP Group 45 species has declined slowly since the mid-1950s.

RESOURCE STATUS AND MANAGEMENT

The origins of modern fisheries stock assessment and management science can be traced as far back as late 19th Century studies of North Sea fisheries. The International Council for the Exploration of the Sea (ICES, founded in 1902) provides assessments and/or management advice for over 100 stocks or sub-stocks in the Northeast Atlantic. The majority of these stocks (approximately 70) are analyzed each year by various ICES Working Groups using age structured stock assessments. The quality of the stock assessments varies and several are considered unreliable because of, either singly or in combination: unreliable or insufficient catch-at-age data; unreliable commercial catch data, particularly in recent years, due to mis-reporting; uncertainty over stock identity; conflicting trends in CPUE series and/or an absence of collaborative data from fishery independent sources. The status of the main resources and stocks is reviewed below.

Northeast Arctic Fisheries (ICES Sub-areas I and II)

Following the near collapse of the Northeast Arctic cod stock in 1988-89 the USSR/Norwegian joint commission agreed a reduction in TAC of over 50% in the offshore fishery for 1990 and 1991. This TAC was well enforced and the reduction in fishing mortality (F), together with a good 1983 year class and improved growth and survival due to abundant prey (capelin - see below), resulted in the rapid recovery of the stock biomass. The stock is

currently considered to be within safe biological limits, although F has nearly doubled since 1990 and is now above F_{med} (0.46). There are concerns that poor growth and increased cannibalism due to the depleted capelin biomass may require F to be reduced from the current level to ensure the stock remains within safe biological limits in the medium term. However, a possible alternative food source, the Norwegian spring spawning herring (see below), is in good condition.

Catches of haddock and saithe are typically an order of magnitude lower than those of cod, and the stocks of both species are considered to be within safe biological limits. Both the stocks of the redfish *Sebastes mentella* and Greenland halibut are below safe biological limits. Redfish catches may have to reduced to the minimum possible for spawning stock biomass (SSB) to increase, while the ACFM recommended that the Greenland halibut fishery be closed in 1996.

The Norwegian spring-spawning herring fishery collapsed in the late 1960s owing to a recruitment failure following the fishing down of the SSB to below 2.5 million tonnes. The SSB remained low until the mid-1980s and virtually no fishing took place on the stock for 15 years. Since the mid-1980s the SSB has increased and in 1994 catches were taken in offshore areas of the Norwegian Sea for the first time in 26 years. Strong year classes are expected to recruit in 1996-1998 and in the short term the stock size is increasing. However, the highly variable recruitment and vulnerability of the stock to collapse means that no long-term gains are expected by increasing fishing mortality above the level of 1995. In order to prevent SSB falling below the minimum biological acceptable level (MBAL), the Advisory Commitee for fisheries Management (ACFM) has suggested that management using limitations on both fishing mortality and total catch is required.

The Barents Sea capelin fishery collapsed for the first time in 1985 and was closed from 1986 to 1991. By 1991 the SSB had recovered to ~1.8 million tonnes - above the levels of the 1970s - and fishing recommenced. However, by 1993 SSB had again collapsed and the fishery was closed. The SSB remains well below safe biological limits and recruitment has been poor since 1992. While the short life span of the species is a key factor in the size of the short-term variation in SSB, the fate of the capelin stock is closely tied to that of its main predator, Northeast Arctic cod. As described above, the Northeast Arctic cod stock was at very low levels in the late 1980s, but has since rallied, resulting in high predation pressure on the capelin. The year classes that will form the majority of the capelin stock for the next 3 years are very weak, and it is unlikely that a fishery will restart before 1999.

The Baltic (ICES Divisions IIIb-d)

The major part of the Baltic is distinct from the rest of the Northeast Atlantic, although there are linkages between the Southwestern Baltic and the Kattegat. The conditions for fish populations in the Baltic are entirely dependent on inflows of oceanic water from the North Sea, with salinity and oxygen availability being high immediately following an inflow and steadily decreasing afterwards. These inflows are irregular, infrequent and vary in strength. Large inflows occurred in 1970, 1974, 1976 and 1979, with a prolonged stagnant period throughout the 1980s before a medium sized inflow in 1993.

Recruitment to the Eastern Baltic cod stock is poor during stagnant periods. The strong year classes associated with good environmental conditions in the late 1970s lead to SSB peaking in 1982 (~1 000 000 t) before declining steadily until reaching a low of ~175 000 t in 1992.

Improved efficiency due to changes in gear and increases in fleet size led to fishing mortality (F) exceeding 1.0 by 1986. Agreed TACs (first set in 1989) have consistently exceeded those advised by ICES and have in turn consistently been exceeded by actual catch levels. Where ICES advised no fishing at all in 1993, the TAC was set at 40 000 t and actual catches were estimated to be ~100 000 t. The extent of unreported landings since 1992 has been large, and serious problems exist in enforcing regulations. Concerns over future recruitment and rebuilding of the SSB led ACFM to recommend a further 20% reduction in F for 1997 relative to the 1995 level. Both the Kattegat and Southwestern Baltic cod stocks are believed to be rebuilding since historically low levels in 1991 and 1992 respectively.

Herring recruitment and SSB are very high for the Gulf of Riga, Bothnian Sea and Bothnian Bay stocks. In contrast, recruitment to the major stock of the Eastern Baltic has been below the 1974-1994 average since the mid 1980s and the SSB reached a historic low in 1991 from which it has not recovered. However, fishing mortality is around $F_{0.1}$ and the stock is considered within safe biological limits.

An assessment of the Eastern and Southwestern Baltic sprat stock shows the SSB reached record levels in 1993-94. The stock is within safe biological limits and catches could be increased substantially. However, sprat, together with herring, is a major prey item for cod in the Baltic and thus natural mortality may be expected to increase with cod abundance.

The North Sea, Skagerrak and Kattegat, and Eastern Channel (ICES Sub-area IV, and Divisions IIIa and VIId respectively)

The main cod stock is the North Sea stock, with both the Skagerrak and Eastern Channel stocks thought to be sub-components. The North Sea cod stock is well outside safe biological limits, with the SSB of 1994 only 3% higher than the historic record low of 1993 and 62% lower than MBAL. The SSB has declined almost monotonically since the peak in 1968, despite the strong year classes of 1969, 1970, 1976 and 1979 (part of the so called "gadoid outburst"), and fishing mortality (F) has fluctuated around ~0.9 since the early 1980s (above F_{med} of 0.81). In the last decade only 2 recruiting year classes have been above average. Following advice in 1991-1993 to cut F directly by 30% relative to 1989, and a "significant reduction" in 1994 and 1995, ACFM has advised for 1996 a cut of 20% relative to 1994. Despite this advice the agreed TAC remained at ~100 000 t from 1991 to 1994 before climbing to 120 000 t in 1995.

The main stocks of haddock and whiting (caught as part of a mixed groundfish fishery with cod) are in the North Sea, with much smaller stocks in the Skagerrak, Kattegat and Eastern Channel. The North Sea haddock stock has improved since the record low SSB of 1991 and, although fishing mortality (F) continues to be high (above F_{med}), the stock is considered to be within safe biological limits. However, if stock size remains at current levels, catches of haddock will continue to be highly variable, depending largely on the strength of individual recruiting year classes. The status of whiting is uncertain due to conflicting trends within the assessment, although it is thought to be within safe biological limits. A separate fishery for saithe throughout the area started in the early 1970s and SSB declined to a historic low in 1990. Assessments indicate there has since been a 25% increase to 1994 and the stock is currently considered to be close to safe biological limits.

The other main demersal species in the area are the flatfish, with the main stocks being in the North Sea. North Sea plaice and sole are the major components of the mixed flatfish fishery. A persistent and rapid decline in SSB in the plaice stock since 1989 resulted in a historic record low in 1994. This decline occurred despite the fact that actual landings and fishing mortality (F) appear to have been smaller than those advised by ACFM since 1989. The stock decline may have been unavoidable (agreed TACs were set higher than advised, and may have been set at such levels regardless of ACFM advice), but ACFM was aware that the stock assessments between 1991 and 1993 were unreliable. The current stock assessment is considered more reliable and, with SSB below MBAL, the ACFM has advised a 40% reduction in F as the minimum requirement to achieve a high probability of recovery above MBAL in the medium term.

After 25 years of average or below average recruitment of North Sea sole, the very strong year classes in 1987 and 1991 have rebuilt the SSB to the highest levels since the 1960s and the stock is considered within safe limits. Both the smaller stocks of sole and plaice in the Eastern Channel are considered within safe biological limits.

The main stocks of sandeels and Norway pout targeted by the small-mesh fishery are found in the North Sea. The North Sea Norway pout stock is considered within safe biological limits, but high bycatches of juveniles of other demersal species, particularly whiting, remain a concern. The North Sea sandeel stock is considered within safe biological limits, with little bycatch of protected species. The fishery on the smaller Shetland stock, closed completely in 1991 following seasonal closures in 1989 and 1990, was re-opened in 1995 after the recruitment of a strong 1991 year class. A multi-annual (3 year) TAC of 3 000 t is set for the stock, which is considered to have recovered above safe biological limits.

Several stocks of shrimp exist throughout the North Sea and Skagerrak. The short-lived nature of *Pandalus spp* in the North Sea means stock status is largely dependent on the recruiting year class. Catches fluctuate widely due either to varying fishing effort as market prices change or changes in stock levels. Recent recruitment to the Skagerrak and Norwegian Deeps shrimp stock has been at average levels, with SSB above average due to a strong 1992 year class.

The status of the North Sea herring stock is catastrophic. The resource status has not been so poor since the virtual commercial extinction of the stock in the 1970s resulted in the closure of the fishery from 1977 to 1981. A modest recovery in the early 1980s resulted in SSB levels climbing briefly above MBAL (800 000 t) from 1987 (the first time this had been true since 1968) to 1992. While the agreed TAC was within the advised TAC from 1987 to 1992 inclusive, actual catches were typically 40% higher. In 1993 ICES advised a reduction in TAC but the agreed TAC was not changed, and actual catches dropped by less than 5%, with the result that actual catches exceeded advised levels by over 50%. The advised and agreed TACs in 1994 remained essentially unchanged from 1993, while actual catch dropped by a further 10%. The advised fishing mortality (F) for 1995 corresponded to a TAC that was actually 24% higher than that for 1994 (due to an overly optimistic assessment) despite SSB levels below MBAL. The 1996 TAC advised by ICES is 298 000 t, with the added recommendation that F be further reduced in 1997, possibly to zero if the 1996 TAC is exceeded. If it were not for recent recruitment being at average levels, it is probable that ICES would have advised that the fishery be closed this year. Given the variability in recruitment to this stock it is clear that

if F is not reduced and SSB is not rebuilt rapidly, the probability that another prolonged period of effective commercial extinction may occur is high.

Iceland, the Faeroe Islands and the Irminger Sea / Greenland (ICES Divisions Va and Vb, and Sub-areas XII and XIV respectively)

The fishery in the Faeroe area is multi-fleet and multi-species. An ITQ-based management system was introduced in 1994 but was deemed a failure, with substantial increases in discarding and misreporting, and a new management system based on individual transferable (within same-gear categories only) effort quotas started in June 1996. The SSB of the Faeroe plateau cod stock was well below MBAL from 1989 to 1993 but has been at, or slightly above, this level for 1994 and 1995. Fishing mortality (F) levels in 1993-94 were the lowest since the 1970s, although not as low as wanted by the ACFM (which advised no fishing at all), and climbed above F_{med} again in 1995. ACFM recommended that F be at the "lowest possible level" in 1996, although the agreed TAC has actually increased by 60%.

A similarly discouraging situation exists for haddock, with the agreed TAC being over 50% higher than that advised by ACFM, despite SSBs around 50% below MBAL since 1991. However, in both cases good recruitment is expected to result in increases in SSB, at least in the short term. The situation for saithe, with SSB at record low levels, is worse, and ACFM advises a 20% reduction in F and a low TAC.

Icelandic demersal fisheries (excluding oceanic redfish) have been managed by an ITQ based system since 1984. The SSB of the Icelandic cod has been at low levels since a slight increase following the increases in mesh size after the adoption of extended fisheries jurisdiction (EFJ) in 1975. Actual catch levels have exceeded those set by the Icelandic government for the past decade and fishing mortality (F) has been correspondingly high. In 1993 recommended TAC levels were set 40% lower, and by 1995 the agreed TAC and actual catch were both around 40% lower than in 1992, resulting in F in 1995 being the lowest since the late 1970s. A formal harvesting strategy whereby TAC is set at 25% of available (> age 4) biomass was introduced in 1995. This strategy is consistent with ACFM advice (although the assessment is uncertain due to difficulties in measuring maturity at age) and is likely to allow rebuilding of the stock. The Icelandic saithe stock is considered within safe biological limits, and the agreed TAC has not been restrictive since 1993, partly due to constraints imposed by the strict TACs introduced in the cod fishery.

All the cod stocks around Greenland remain almost non-existent, and ICES recommends that no fishing should take place. The other main northwestern demersal resources are Greenland halibut and redfish. Each year since 1992 the F on Greenland halibut has reached a new historic high level, and SSB is now close to a record low. There is considerable uncertainty in the estimate of SSB, and fishing mortality (F) is thought to be underestimated. ACFM has recommended a cut of 60% in F from 1995 levels. The redfish resource is made up of two species, *Sebastes marinus* and *S. mentella*, with *S. marinus* supporting a shelf fishery down to 500m while *S. mentella* supports both a pelagic oceanic fishery and a deep-sea fishery in the Irminger Sea (0 to 500m, and below 500m respectively). The ranges of the three stocks differ, and different fisheries exist on different parts of the ranges. The catches of oceanic *S. mentella* in ICES Sub-areas XII and XIV are almost all taken in international waters, although the same stock is found, at least at certain times, within the EEZs of Greenland and Iceland. Both the *S. marinus* and deep sea *S. mentella* stocks are thought to be at very low levels, and ICES

advises a cut in F of 25% from the 1995 levels. There is great uncertainty over the status of the oceanic *S. mentella* stock. This uncertainty prevented ICES giving any catch advice although the possibility that recruitment could fail for several years before being observed is of concern.

The Iceland summer-spawning herring stock SSB is currently at a historically high level. Following the collapse of the stock in 1968 a ban on fishing was enforced from 1972 to 1975 and, with fishing mortality (F) levels low since then (around $F_{0.1}$), the SSB has increased nearly continuously since 1971. Recruitment has also been increasing and the stock is healthy, although increasing F will not provide long term increases in yield. Good recruitment has lead the capelin stock SSB to recover very quickly from the unsafe low level of 1990 and it is now at a record high, although there is considerable uncertainty in the assessment which is based on acoustic surveys. There is concern that F on juveniles should be minimised, possibly via seasonally closed areas.

The West of Scotland and Rockall, the Irish and Celtic Seas, and the Bay of Biscay (ICES Divisions VIa-b, VIIa-c and VII e-k, and VIIIa-b respectively)

The cod stocks of the West of Scotland, Rockall, Irish Sea and Celtic Sea are all considered to be outside safe biological limits to varying degrees, and ACFM advises reductions in fishing mortality (F). The saithe stock (West of Scotland and Rockall) is considered outside safe biological limits, with SSB still close to the record low level of 1992. F is estimated to have dropped sharply in recent years (although the figures are uncertain) and ACFM advises that low levels be maintained.

Catches of Irish Sea plaice have generally been below advised TACs since 1988, but the SSB declined below average levels in 1990 and has yet to recover significantly. However, these historically low levels of SSB do not appear to be sufficiently low to reduce recruitment and the stock is considered close to safe biological limits. However, similarly historically low levels of SSB of Irish Sea sole are associated with poor recruitment and a 20% reduction in fishing mortality (F) is advised. The Celtic Sea plaice and sole stocks are considered to be near safe biological limits and a 20% reduction in F is advised. Low levels of SSB for plaice in the Western Channel has lead ACFM to advise a 60% reduction in F. Since TACs for plaice in the Western and Eastern Channel are combined and the Eastern Channel stock is much larger, a direct reduction in F rather than TAC is necessary. Western Channel sole are also close to biologically safe limits and ACFM calls for a reduction in F. The fisheries for different species of anglerfishes towards the south are managed together and ACFM advises no increases in F.

There are several herring stocks in the area, all of which are small relative to the main North Sea stock. The spawning biomasses of all these stocks appear to have been at low levels in the 1970s. While most of the stocks have increased almost continuously since (VIa, VIIa,j), the SSB for the stock in VIa (South) and VIIb-c has decreased since the late1980s. The level of uncertainty associated with the assessments of these stocks is generally high.

Iberian Region (ICES Division VIIIc and Sub-areas IX and X)

Hake is the major demersal resource of the Iberian region, together with anglerfish and megrim. The SSB of hake in 1994 was at a record low and ACFM advises that fishing mortality (F) be kept at the lowest possible level, preferably zero, in order to allow spawning

biomass to rebuild. The main stocks of megrim (taken as bycatch in the hake fishery) and anglerfishes are thought to be at low levels. The Southern horse mackerel stock appears stable, but the sardine stock is at low levels and ACFM advises that catches should be reduced as much as possible. A change in catch composition towards juvenile anchovy in the anchovy fishery suggests that spawning biomass is low. ACFM suggests that a seasonal closure to protect juveniles could increase SSB and safeguard recruitment without causing significant reductions in catch.

North Atlantic and Baltic Salmon Stocks

There are over 1000 salmon rivers in the North Atlantic Salmon Conservation Organization's (NASCO) North-east Atlantic Commission (NEAC) Area, and MBALs have been established for only seven. These monitored rivers suggest that there is no trend in smolt production in the Northeast Atlantic as a whole. Stocks in the main basin of the Baltic are in better condition than those in the Gulfs of Bothnia and Finland in the Baltic, which are severely depleted. Less than 50% of the original stocks still exist, and catches are only sustained by reared salmon (which make up over 90% of the catches). All stocks have been badly affected since 1992 by the M74 syndrome, a condition which causes high mortality in newly-hatched yolk-sac fry from sea-run females. The cause(s) of this disease is still under investigation, although thiamine deficiency resulting from consuming prey with high thiaminase activities is gaining credence over theories regarding organochlorine contamination.

Widely Distributed, Deep-Water and Migratory Stocks

Blue whiting are caught from the Barents Sea to the Straits of Gibraltar and, although absolute population estimates are imprecise, the stock does appear to have been relatively constant since the early 1980s. Mackerel, now assessed as a single stock, may be outside safe biological limits and ACFM advises a significant reduction in fishing mortality (F). The western horse mackerel stock is within safe biological limits. Northern hake are found from the Bay of Biscay to the Celtic, Irish and North Seas. The stock is considered to be outside safe biological limits and ACFM advises a 30% reduction in F and improved enforcement of mesh size and minimum landing size regulations.

Deep-water species such as the argentine or greater silver smelt, roundnose grenadier and Atlantic orange roughy, along with many other species of fish (>20) and sharks (>10), are now caught in deep-water fisheries. The long life-span and associated low rate of increase of many of these species means that catches can be sustained for a number of years as the stocks are "mined" before suddenly collapsing. ICES has advised a precautionary approach where effort is kept as low as possible while understanding about the response of these species to fishing is improved. A first step in gaining such an understanding is identifying the most important components of the catch at the species level and reporting their catches.

Environmental Issues

Trawling with heavy gears is thought to have a major impact on the sea bottom, altering and degrading marine habitats and possibly causing loss of species diversity. Demonstrating statistically significant causal links between sea bottom degradation and fish production will be difficult, even if such links may exist, but a comprehensive impact assessment has not been carried out. Concern has been expressed over possible damage to the spawning grounds of

Celtic Sea herring caused by gravel extraction along the Irish coast. Other environmental concerns arise out of the growth of mariculture and sea ranching and potential impacts on wild population genetic make-up (e.g. Baltic salmon).

Management Issues

The above review of the commercial fish resources of the Northeast Atlantic reveals that the majority of the resources are fully or overexploited, with several stocks in a depleted condition. This situation has been brought about largely by long-term overfishing, although environmental factors may have played a significant role in a few stocks. The review highlights the fact that catches often exceed agreed TACs, that agreed TACs often exceed those advised by ICES, and that advised TACs have been based on uncertain, and often optimistic stock assessments.

The large overcapacity of the European fleet and the poor status of many of the resources has led to agreed TACs being restrictive for an increasing number of stocks. The difficulties inherent in enforcing output based fisheries regulations such as TACs (rather than input based measures such as limited entry) and the resulting low probability of detecting transgressions creates economic conditions that encourage illegal overfishing. Hence, actual catches exceed restrictive agreed TACs. In an effort to improve this situation, the EU Commission called for cuts of up to 40% in the size of certain fleets to be included as part of the Fourth Multi-Annual Guidance Programme (scheduled to run from 1997 to 2002).

The agreed TAC of a given stock can also be exceeded because fish from the stock are taken as bycatch in fisheries targeting other species. This bycatch can be landed as illegal over-quota fish or can be discarded at sea in conformity with the current legal requirement. Discarding is a significant factor in the Northeast Atlantic fisheries, and in part appears to be a consequence of setting quotas on individual species in what are mixed species fisheries. This encourages high grading and discarding that some estimates put as high as 50% of the demersal catch by weight, although the general absence of observers on commercial vessels makes quantification difficult. Some countries have started sampling programmes where observers sample discards on a haul-by-haul basis.

Illegal catches are either not reported at all or are reported as different under-quota species, resulting in a deterioration in the quality of fisheries statistics used for stock assessments. This situation is worsening and is a cause for great concern. The ACFM has warned that, if data quality continues to deteriorate, it will become impossible to monitor certain stocks, particularly with regards to the provision of short-term forecasts used for setting TACs. The under-reporting of catches, particularly where the level of under-reporting is unknown and/or fluctuates widely, can result in the under-estimation of stock size, which, in turn, results in larger discrepancies between actual and predicted catch rates. As this discrepancy grows, the incentive for fishers to continue fishing illegally increases and the degree of under-reporting of catches increases. This combination of high exploitation intensities and poor quality data has lead to concerns over the future effectiveness of TAC-based quota management. For instance, the ACFM suggests that stand-alone technical measures or catch controls are likely to be insufficient in reducing fishing mortality on the Irish Sea cod stock such that spawning stock biomass can return to safe biological levels.

There is currently considerable research effort going into the reduction of bias and uncertainty in stock assessments and improving the way in which these factors are communicated to decision makers. For instance, predator-prey interactions that lead to variability in certain stock parameters (e.g. natural mortality and growth) have been investigated using multi-species virtual population analyses (MSVPA) based on data collected by large-scale stomach sampling programmes. Additionally, the problems with commercial data highlighted above have led to increasing use of research vessel survey data in estimating current stock sizes.

However, it is clear that better assessments are not sufficient for improved management. In addition to the illegal over-quota fishing problems noted previously, the pattern of agreed TACs exceeding advised TACs continues. The form of advice being given by ACFM has improved over the past decade and the problem of agreed TACs exceeding advised TACs cannot be attributed solely to poor understanding of this biologically based scientific advice on the part of fisheries administrators. In European waters, the EU Council is required to take into account economic and social conditions as well as resource status when agreeing on TACs. The implications on stock status of considering increased catches based on these factors remains uncertain but is of concern.

The above review highlights the fact that many past decisions on the setting of TACs (and/or levels of fishing effort) appear inappropriate in light of the biologically based advice. The pattern of agreed TACs exceeding advised TACs has contributed, together with the enforcement problems and stock assessment uncertainties discussed above, to the poor long-term performance of TACs as management measures. In contrast, effective management of fishing fleets with reduced capacity could provide many benefits, including increased overall landings and economic yields, increased profitability and increased stability in catches, while reducing the risk of stock collapse.

3. WESTERN CENTRAL ATLANTIC

FAO Statistical Area 31

INTRODUCTION

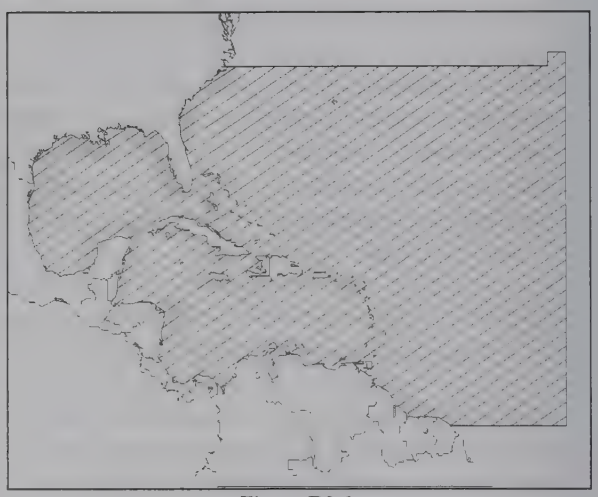


Figure B3.1

The waters incorporated in Area 31 (Figure B3.1), the Western Central Atlantic, centered on the Caribbean and Central American States, include a diverse array of fisheries and harvested fish species. The FAO FISHSTAT system has records of 147 species or species groups being caught in these waters between 1950 and 1994. The species groups reported include categories such as "marine molluscs: not identified" and "finfishes: not identified", so the actual number of species harvested is likely to be much higher. A total of 26 states from the area have recorded landings on the system and many of these would include fisheries ranging from artisanal to commercial operations within their national fisheries. The oceanography of the region is heavily influenced by the runoff of the major river systems of the Mississippi, Orinoco and Amazon rivers. These river systems, demonstrating mesoscale variability in runoff, contribute to inter-annual variability within the marine system which is also influenced by other climatic factors, including hurricanes .

The fisheries of the region have been characterized by generally increasing catches in recent decades as fishing pressure has risen. However, knowledge of the status of the stocks being

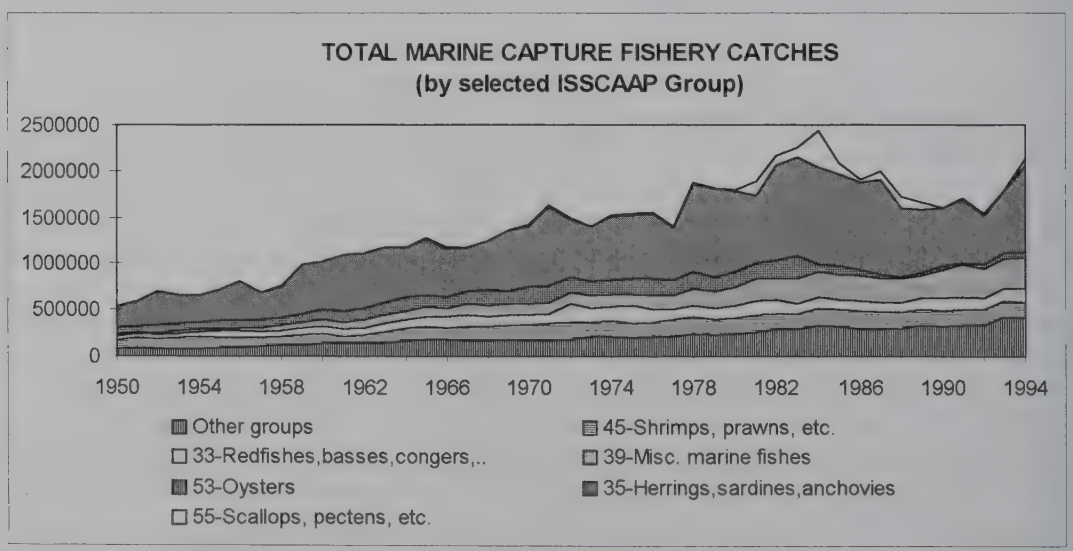


Figure B3.2

harvested is generally poor, and sustainable levels of fishing mortality are essentially unknown for most species. There is a common belief that many stocks are being fully or over-exploited and there is concern for the status of species such as Nassau grouper *Epinephelus striatus* and jewfish *E. itajara*, the spiny lobster in some regions, and the queen conch. The greatest need in the region is for improved knowledge of the status and potential productivity of the stocks and of the fisheries harvesting them, to enable implementing appropriate management action.

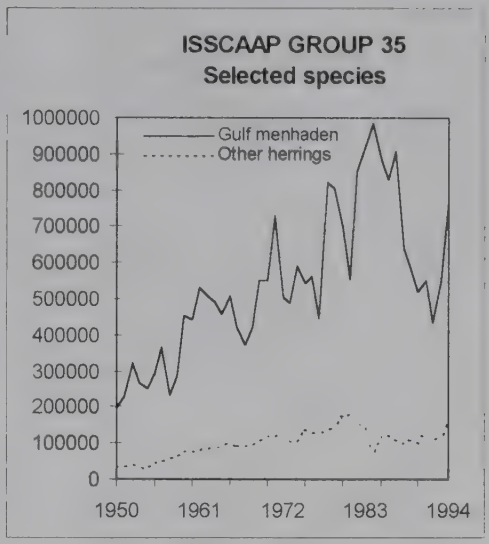


Figure B3.3

PROFILE OF CATCHES

The total fish landings from the area have increased fairly steadily since 1950, reaching a peak at over 2.5 million tonnes in 1984 before falling until 1992, followed by a recovery in 1993 and 1994. In 1994 they stood at over 2.1 million tonnes, compared to an average of less than 1.5 million tonnes between 1950 and 1994 (see Figure B3.2 and Table III).

The single major contributor to the landings at the ISSCAAP Group level are the pelagics of Group 35 (herrings, sardines and anchovies, etc.). Of these, ranking first and third respectively in terms of 1994 landings were the Gulf menhaden and the Atlantic menhaden. The landings of these two species in 1994 were 767 000 t and 37 500 t respectively, the former showing some recovery after the decline in landings in the late 1980s and early 1990s, while those of the latter remained substantially lower than the peak of the early 1980s. Combined, they represented 80% of the landings of pelagic species in ISSCAAP groups 34 and 35, and 38% of total landings from the region. There has also been a generally increasing trend in landings of small pelagics since the early 1970s (Figures B3.3 and B3.4). The small pelagics from Group 35 providing the largest landings, apart from those of menhaden, are largely clupeoids, particularly round sardinella and Atlantic thread herring. Within Group 34, the unidentified mullets and the Flathead gray mullet yielded the greatest landings in 1994 followed by the *Caranx* species (Table III).

In 1994 the largest landings of large pelagics in ISSCAAP Group 36 (tunas, bonitos, billfishes etc.) came from yellowfin tuna (28 000 t), Atlantic Spanish mackerel and king mackerel (19 000 t and 9 000 t respectively) and skipjack tuna (8 000 t). Landings of ISSCAAP Group 36 species have shown substantial increases over the period 1950 to 1994 (Figure B3.5).

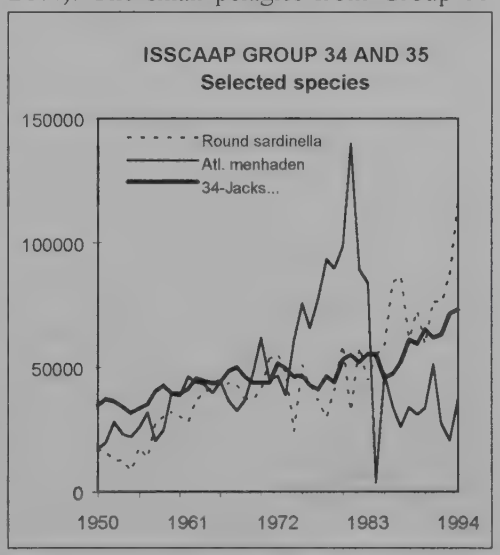


Figure B3.4

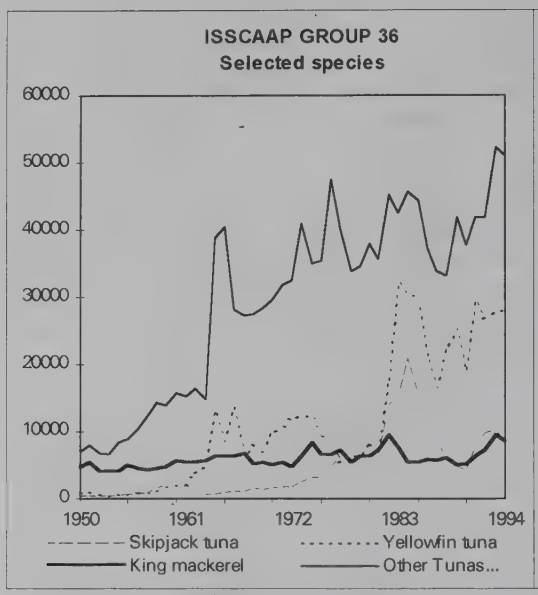


Figure B3.5

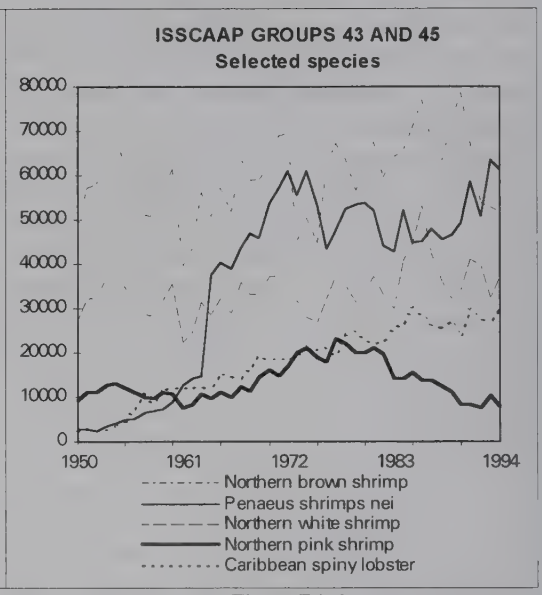


Figure B3.6

Contributing substantially less than the small pelagics in terms of landed weight, but certainly of considerable total economic value, are ISSCAAP Group 45 (shrimps, prawns etc.), Group 33 (redfishes, basses, congers etc.), and the other higher value species groups. A cause for concern is the substantial increase in ISSCAAP Group 39 (miscellaneous marine fishes) (Figure B3.2). This group accounted for approximately 40% of total finfish landings in 1994, excluding menhaden. Without accurate data on the species composition of landings, and associated information on effort, it is impossible to assess the status of the stocks, and better identification of fish landings should be given a high priority by those countries in the region which are failing in this regard.

The fisheries for crustaceans in this area are dominated by those for the Caribbean spiny lobster and penaeid shrimps, the latter particularly from the Gulf of Mexico and the Guianas-Brazil subregion. Landings of the spiny lobster have increased fairly consistently since 1950 (Figure B3.6) while the total annual shrimp catch from the region has fluctuated around approximately 170 000 t for two decades The production of shrimps and prawns by aquaculture has grown substantially in recent years, reaching over 11 000 t in 1994 or 7% of the total shrimp production, including aquaculture, from the region (Figure B3.6).

Several mollusc species support valuable fisheries in the area, in particular the fisheries in the USA for cupped oysters and calico scallops. In 1994, recorded landings for these species were 59 000 t and 74 000 t respectively, the latter showing recovery after the dramatic decline of the early 1990s. Production of cupped oysters was supplemented by the culture of nearly 90 000 t of the species in Mexico and the USA in that year. Landings of queen conch have increased substantially over the last 25 years but declined somewhat after a peak at nearly 8 000 t in 1984 (Figure B3.7). In 1993 landings again rose above 8000 t, but declined to just more than 7 000 t in 1994. The status of the stock is currently causing concern.

RESOURCE STATUS AND MANAGEMENT

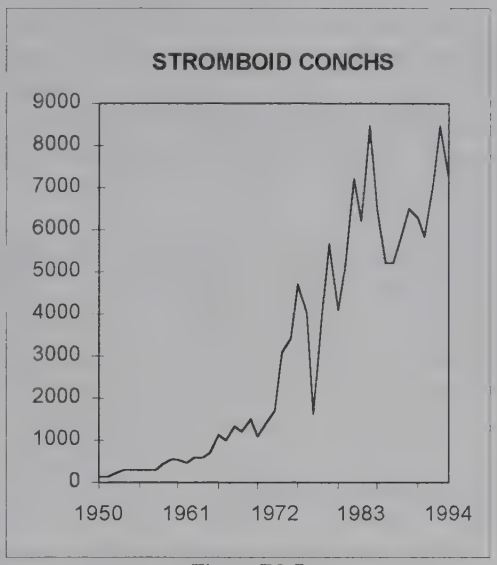


Figure B3.7

Despite a scarcity of hard information and few rigorous assessments, there is general concern for a number of the species and stocks in the region. One such group is that of the sharks and rays, in which landings have increased substantially in recent years, reaching a peak of nearly 34 000 t in 1994, over double that landed, on average, between 1950 and 1994. The nations taking the largest landings of these species in 1994 included Mexico, Venezuela and the USA, all of which have shown increasing landings in recent years. In addition, many species of reef fish have been reported as being fully or overexploited, including Nassau grouper and jewfish. Within ISSCAAP groups 33 (Redfishes, basses, congers etc.) and 39 (Miscellaneous marine fishes), which include most of the reef-fish species, the two highest landings categories, together accounting for nearly 70% of the total landings for the group, were unidentified marine fishes and finfishes. Clearly there is little hope for rigorous management for sustainable utilization as long as this problem remains. Of the identified landings, the greatest landings were made of unidentified groupers (*Epinephelus spp.*), unidentified snappers and jobfishes (Lutjanidae), unidentified weakfishes (*Cynoscion spp.*) and unidentified sea catfishes (Ariidae). In all of these groups landings for 1994 were above 10 000 t (Table III).

The demersal fishes of the region support important fisheries. The most important commercial fishery utilizes hook and line and occasionally traps to catch the deep reef fishes, particularly snappers and groupers, while trawl fisheries catch mainly the croaker and drum multispecies category. Considerable attention is being given to reduction of finfish bycatch in the shrimp fishery, particularly through the use of bycatch reduction devices, but finfish bycatch, including substantial proportions of juveniles, is still cause for concern.

The pelagic fisheries of the area may be divided into large offshore pelagics with oceanic distribution, large coastal pelagics with a regional distribution and small pelagics. The first group includes fish such as the billfishes, tunas and swordfish. Most of these species are assessed by the International Commission for Atlantic Tunas (ICCAT) and most are considered by the Commission to be fully or over-exploited. Any plans to expand the fisheries for these species within the region should therefore be made within the ICCAT framework, and proper representation of the smaller nations within WECAFC on this body should be seriously considered by fisheries departments in the region. This is clearly an example where regional cooperation is urgently required. In contrast to the stocks falling under ICCAT, the status of the stocks of the more common locally distributed large pelagics, such as mackerel *Scomberomorus* species, blackfin tuna and common dolphinfish is unknown. The round sardinella and Atlantic thread herring are generally caught close to the continental mainland and the larger islands such as Trinidad and Jamaica. Fisheries for small pelagics on the smaller islands making up the lesser Antilles largely make use of beach seine nets and are locally important providers of employment and food. They tend to be based on carangidae, that is the

jacks and scads, such as *Selar crumenophthalmus* and *Decapturus spp.*, and halfbeaks (*Hemiramphus spp.)*.The flyingfish (*Hirundichthys affinis*) makes up only a low proportion of landings of small pelagics, but is important to the southeastern Caribbean states. Only two countries, Barbados and Granada, have recorded catches of this species on FAO FISHSTAT, but at least seven island states have fisheries for the species and there is considerable interest in increasing exploitation.

The main crustacean fisheries are those for spiny lobster and penaeid shrimps. Total landings of spiny lobster in 1994 amounted to nearly 30 000 t, with the fishery dominated by Cuba (9 700 t) and the Bahamas (7 800 t). The USA, Nicaragua and Honduras also recorded landings of over 1 000 t. The resource is generally considered to be over-exploited in many countries and a more holistic and effective management strategy is required for the region. Steps are being taken in this direction and, for example, both Cuba and the Bahamas have taken active steps to implement appropriate management measures. A workshop aimed at undertaking a regional assessment of these resources is scheduled for the first half of 1997.

In 1994 the total shrimp catch from the region was over 160 000 t. Of this, and including aquaculture, the USA accounted for over 100 000 t. Other major producers included Mexico (23 000 t), Venezuela (14 000 t), Colombia (9 000 t) and Guyana (7 000 t). Probably the major concern with this fishery is the issue of bycatch, both of finfish and of turtles. Finfish species taken as bycatch include species such as croaker (*Micropogonias spp.*), snapper (*Lutjanus spp.*) and dog trout (*Macrodon ancylodon*).

Several mollusc species support valuable fisheries in the area, in particular the fisheries in the USA for cupped oysters and calico scallops. In 1994, recorded production of these species, including aquaculture, was 146 000 t and 74 000 t respectively, the latter showing some recovery after the dramatic decline of the early 1990s. The queen conch fishery is cause for some concern, and the stock is considered to be over-exploited in most countries in the area. As a result, the species has been listed on Appendix II of CITES. Mexico has the largest landings of this species. Serious attempts are being made to assess the status of the species and determine appropriate management responses. An "International Queen Conch Conference" was organized by the Caribbean Fishery Management Council in mid-1996 to consider approaches to assessment and management of the species.

Environmental degradation presents cause for concern in some areas and fisheries within the region. The coastal habitats are vulnerable to on-going coastal development and to impacts from inland developments such as pollution and damming of rivers. The Committee for the Development and Management of Fisheries in the Lesser Antilles of WECAFC recently called for investigations into the impacts of environmental degradation as a priority. Loss of important coastal nursery areas such as mangrove and sea grass habitats, are specific examples of problems being experienced. Coral reefs, important habitats in the region of substantial socio-economic importance through both tourism and fisheries, are also being degraded. The Final Report of the International Coral Reef Initiative Workshop in 1995 reported on incidences of declines in reef fish populations and coral cover across the region. These changes were being brought about by factors such as terrestrial runoff of both sediments and nutrients, direct physical damage to the reefs in a number of ways, and overexploitation of fish resources. Clearly, attempts to sustainably utilize the renewable marine resources must incorporate appropriate environmental management.

4. EASTERN CENTRAL ATLANTIC

FAO Statistical Area 34

INTRODUCTION

The Eastern Central Atlantic, off the West coast of Africa, from the Gibraltar Strait to the mouth of the Zaire river (Figure B4.1) and encompasses temperate, tropical, and equatorial waters, lagoons and mangroves as well as oceanographic features such as major currents, upwellings, and equatorial convergence. About 190 species or groups of species were caught in the area during the 1950-1994 period by a total of 22 area States and 25 distant-water fishing nations.

Figure B4.1

The fisheries in the region are characterized by the dominance of small pelagics, especially sardine and other clupeids that account for nearly 50% of total catches. In the late 1980s, changes in Eastern Europe first resulted in the appearance of a number of new distant-water fishing nations. Lately, changes in economies in these countries and the increased emphasis placed on market forces have resulted in a reduction of catches in Area 34, especially of small pelagic fishes.

PROFILE OF CATCHES

After the record figure of about 4.1 million tonnes in 1990, total reported catch for Area 34 have reduced to 2.9 million tonnes in 1994 (Figure B4.2 and Table IV). Apart from above-

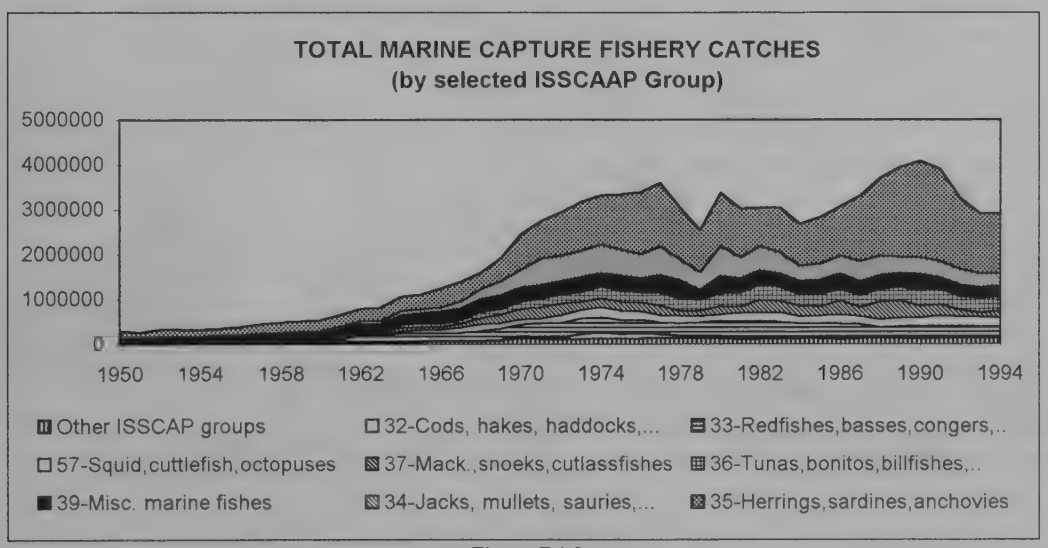


Figure B4.2

average landings between 1988 and 1991, annual totals varied between 2.5 million tonnes and 3.3 million tonnes throughout the 1970s and 1980s. These variations are mainly to be attributed to fluctuations in small pelagic resources such as horse mackerel and sardine, largely influenced by climatic changes as well as changing fishing pressure from Eastern Europe countries.

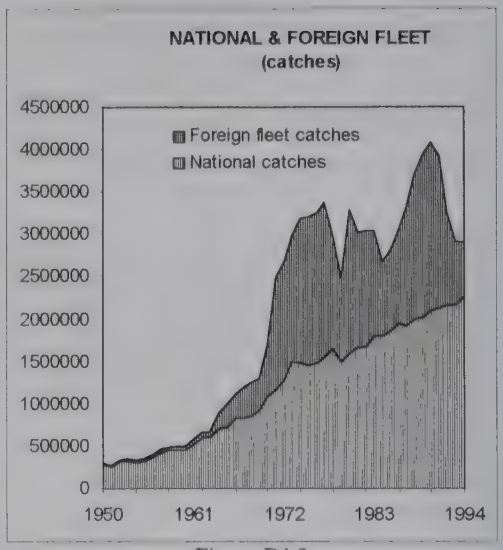


Figure B4.3

In 1994, 22 coastal states recorded 78% of the area production. The steady development of their national fisheries results in an average 20% increase per year since 1950 (Figure B4.3). Long-range fishing fleets of 25 foreign countries mainly catching small pelagic fish account for 22% of the catch in 1994. This proportion is markedly reduced compared to earlier levels which exceeded 50% in 1971-77.

The major contributor to catches in the area are the species of ISSCAAP Group 35 (Herrings, sardines, anchovies, etc.) which represent 46.6% of 1994 catches (Figure B4.2). The catches of European pilchard (or sardine), *Sardina pilchardus*, accounted for 50% of the total for the group in 1994. In earlier years, especially in 1989-91 and in 1976, that proportion had exceeded 70% (Figure B4.4). Catches of round sardinella, after an increase from 1984 to 1991, show a sharp decrease and have now returned to the levels of the early eighties. Catches of European anchovies remained at a low level, except between 1987-91, when they reached a peak of 347 000 t in 1990.

The majority of ISSCAAP Group 34 (jacks, mullets, sauries, etc.) catches come from horse mackerel (included in jack and horse mackerels nei, Figure B4.5). Catches of these species increased sharply in the late 1960s, remained high through most of the 1970s but declined through most of the 1980s and 1990s. The other main finfish ISSCAAP Groups are 37 (mackerels, snoeks, cutlassfishes, etc.) and 32 (cods, hakes, haddocks, etc.). Catches of chub mackerel dominate Group 37, with two exceptional years in 1988-89, followed by a collapse in 1993 and slight recovery in 1994, while the Senegalese hake has been the major contributor to Group 32, with huge catches in the 1970s and relatively steady but much lower catches since. European hake catches are stable between 10 000 t and 13 000 t since 1986.

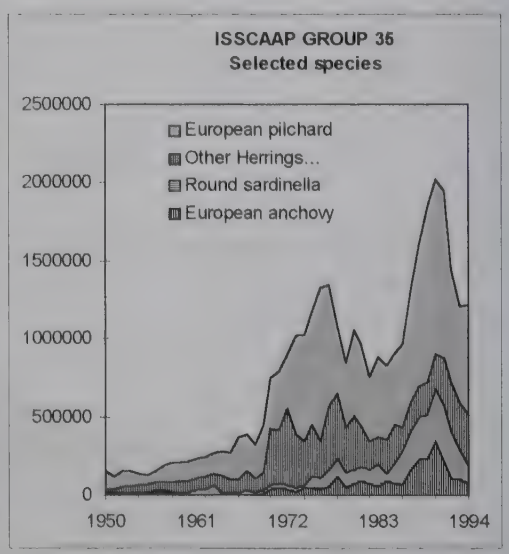


Figure B4.4

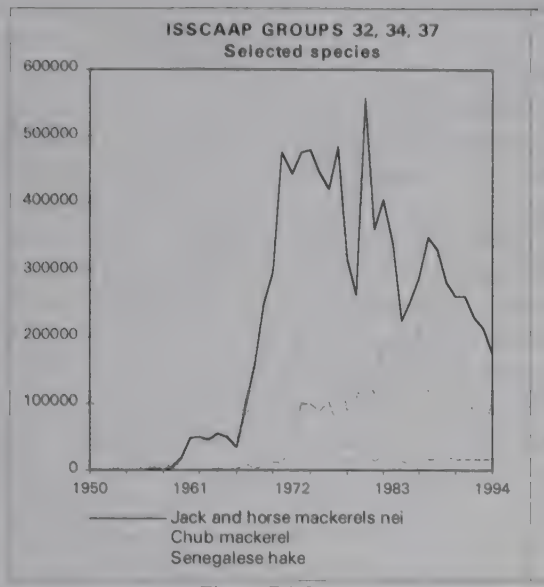


Figure B4.5

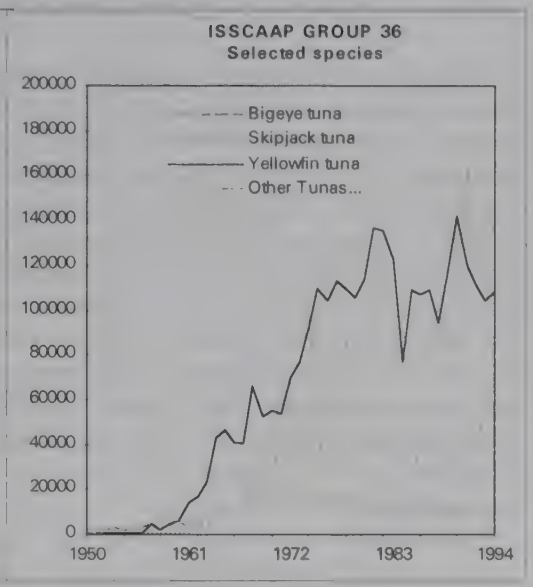


Figure B4.6

Catches from ISSCAAP Group 36 (tunas, bonitos, billfishes, etc.) represent 11% of 1994 total catches, a proportion that remained similar since 1966. Yellowfin and skipjack are the dominant species (Figure B4.6). Yellowfin catches increased regularly since 1960 to reach a maximum of 137 000 t in 1981. After a sharp decrease in 1984-88, yellowfin catches are now showing an upward trend, though with greater variability. The skipjack fishery started in 1967 and has since developed to reach 135 000 t in 1994. Bigeye, the third species in the group, has increased in recent years to reach 58 000 t in 1994. Catches of other small tuna and billfishes caught by the fishery have regularly decreased since 1972.

Catches of ISSCAAP Group 45 (shrimp, prawns, etc.) represent 1.4% of the total catches (Figure B4.7). Southern pink shrimp catches started to become significant in 1966 and have since regularly increased with a sharp peak, reaching 19 000 t in 1993 before declining to 14 000 t in 1994. The deepwater rose shrimp fishery started from nothing in 1971 and catches have shown a great variability, with a very high value of 19 000 t in 1978 but only about 5 000 t in 1986-88 and 1992-94.

Catches of ISSCAAP Group 57, (squid, cuttlefish, octopus, etc.) (Figure B4.7) represent 6.9% of 1994 total catches. The octopus fishery started off in 1966 and has since kept an upward trend, though with large variations, to reach 135 000 t in 1994 (Figure B4.8). Catches of cuttlefish have been relatively constant around the value of 40 000 t.

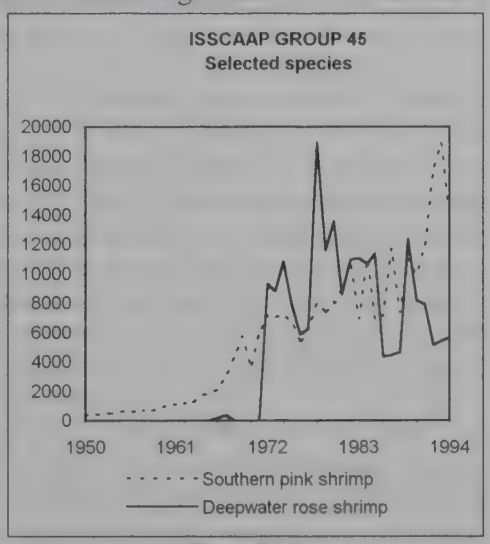


Figure B4.7

RESOURCES STATUS AND MANAGEMENT

This review of the status of stocks is based on assessments undertaken by recent ad hoc Working Groups on the evaluation of the major fisheries resources in the region and conclusions of the Working Party on Resources Evaluation of the Fishery Commission for the Eastern Central Atlantic (CECAF), Accra, Ghana (10th Session, 10-13 October 1994) and the Fishery Committee for the Eastern Central Atlantic (CECAF), Dakar, Senegal, 18-20 December 1995. Quantitative estimates of potential catches for many stocks were obtained during CECAF ad hoc Working Groups.

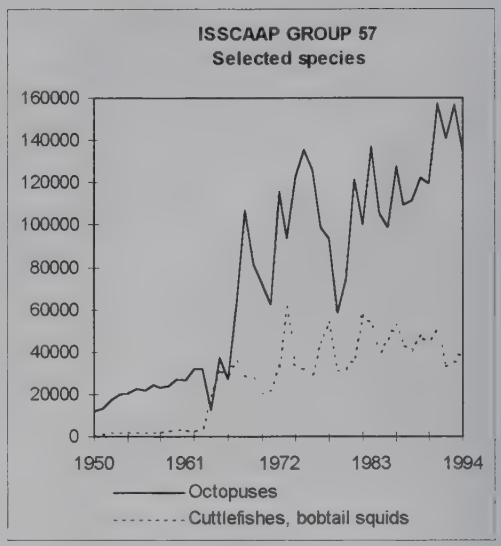


Figure B4.8

Northern Areas

Total catches of demersal stocks on the Mauritania continental shelf have decreased from 36 000 t (1984) to 12 800 t (1992), which could reflect a change in fishing strategy (e.g. replacement of target species, increase of discarded fishes, incomplete statistics, etc.). Hakes have been considered moderately exploited while other demersal fish species are more intensively exploited. Quantitative evaluation of many demersal resources has not been undertaken due to the unavailability of required data. Demersal resources off Senegal are considered slightly over-exploited. The Maximum Sustainable Yield (MSY) for these resources is estimated to be around 130 000 t (1994). Coastal demersal resources off The Gambia are fully or over-exploited with MSY estimated at 15 000 t (1993).

Two stocks of common octopus are caught by the Northwest African cephalopod fisheries. The northern one, off the Saharan coast, is believed able to support a potential MSY catch of 75 000 t. The southern one off Cape Blanc, is considered fully or overexploited, with an estimated MSY of 50 000 t. Catches from the southern stock in 1992 (a total of 44 000 t landed in Mauritania) have returned to the high levels observed in 1986-87. This recovery is not due to fisheries management, but rather to a drop in catch rates resulting in a 40% reduction in fishing activity of the trawler fleet and a decrease in the proportion of juveniles in the catches during 1987-92. Exploitation patterns have improved as a result of use of selective gears by the artisanal fishery. The level of exploitation of other species of cephalopods, such as squids and cuttlefish, is lower than that of octopus: their catches account for 15% of the cephalopods landed. Landings of octopus and associated by-catch species from the Northwest African cephalopod fisheries have shifted during recent years from Las Palmas to other ports in Northwest Africa. Management measures taken in Morocco include a two month closed season and a reduction of foreign vessels operating in the area.

The MSY of the central sardine stock of Morocco was estimated to be some 550 000 t and the present level of exploitation is considered moderate. The large stocks of small pelagics in this region - sardine, mackerel and horse mackerel - are highly variable, and their assessment difficult. Acoustic surveys carried out off Northwest Africa in 1992 showed that the school density of small pelagics (mainly sardinella, sardine excluded) was very high, particularly off Mauritania, with biomass estimated at about 4 million tonnes. In addition, the biomass of

mackerel and horse mackerel in the area between Morocco and the Bissagos Islands was estimated to be 830 000 t.

The potential MSY catch of total small pelagic species (other than sardine) in the zone from Sahara to Senegal was estimated at 1 200 000 t. Until 1992, the different species groups of sardinella, horse mackerels and mackerels were moderately exploited. The level of exploitation of coastal pelagic resources has reduced with the decrease of fishing activities of Eastern Europe fleets. The profitability of different options for fishing, processing and marketing of catches should be studied at national level with a view to finding the best options for taking catches formerly harvested by foreign fleets.

In Mauritania area, pink spiny lobster stocks continue to be heavily exploited. Northern and southern stocks of green lobsters are probably over-exploited. A clam stock (*Venus rosalina*) with a potential of about 300 000 t had been discovered off the coast of Mauritania and is still unexploited for commercial reasons. Stocks of deep-sea crab (*Chaceon maritae*) seem to be reasonably exploited. The present level of catch of deep-sea shrimp (*Parapenaeopsis atlantica*) is around 1 200 to 2 400 t, and the state of stocks seems to allow a possible controlled increase of shrimp fishing activities.

In Cape Verde waters the most important resources are tunas. Spiny lobsters are now fully exploited and a freeze in fishing effort has been recommended. Updated potential catches of demersal fish are not available, and it is possible that marine fisheries resources in Cape Verde are not fully exploited.

Southern Areas

The continental shelves of Guinea Bissau, Guinea and Sierra Leone are characterized by coastal fish assemblages (croakers) principally located in nutrient-rich estuarine and inshore areas. Trigger fish that appeared in large quantities in the seventies have now completely disappeared. The exploitation rate applied to cuttlefish stocks has been increasing since 1984 and by 1990 was considered to be equal to, or slightly above, the optimal fishing effort. The rate of growth of these organisms appears faster than previously estimated.

In Guinea, current estimates based on recent trawl surveys indicate a total biomass of demersal resources to be around 180 000 t, of which 44 000 t are of high or medium commercial value. Assessments made by CECAF in 1991 were updated in 1994 (Working Group held at the Centre national des sciences halieutiques de Boussoura, Conakry, Guinea) and show that total demersal biomass decreased by around 50% between 1991 and 1994. The decrease in biomass of the main demersal species, such as croakers, threadfins and sicklefish, was higher than 50 percent. It was suggested that this change in biomass was related to the recent increase of small-scale artisanal and industrial fishing effort. Interactions with the more commercial large-scale fisheries has led to major problems for the traditional artisanal fishery. Fishery production of the coastal area up to 20m depth was estimated at about 40 000 t per year.

Trawl surveys carried out on the Guinea continental shelf have shown that between 1985 and 1990 the estimated biomass of coastal resources in waters less than 20 m deep (roughly up to 15 nm offshore) declined from 112 000 to 49 000 t during the rainy season and from 72 000 to 48 000 t during the dry season. This reduction between 1985 and 1990 can be explained by the increase in fishing activity of trawlers in inshore areas.

In Sierra Leone, small pelagic species are exploited by the artisanal fishery only. Their current level of catches ranges between 22 000 and 30 000 t. Acoustic surveys have estimated biomass to be between 70 000 and 120 000 t, suggesting that controlled development of the industrial sub-sector may be possible. Current annual landings for demersal stocks by trawlers ranged from 8 000 to 20 000 t between 1991 and 1993. Reduced catch rates are currently observed in the fishery and the level of exploitation of demersal fish stock is considered high. MSY has been estimated to lie between 46 500 t and 65 000 t.

Current annual production of Southern pink shrimp in Sierra Leone was found to fall within the MSY estimate of 2 600 to 3 500 t. Reduced catch rates are currently observed in the fishery, and the level of exploitation of shrimp is considered high. In the west and central Gulf of Guinea, potential catches of shrimps were estimated at 4 700 t, and stocks were considered over-exploited. Demersal resources are fully exploited with biomass estimates ranging between 64 000 and 104 000 t.

Marine resources of the Gulf of Guinea are mainly exploited by Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon and Equatorial Guinea, among others. Multi-species fisheries are common in the Gulf of Guinea. Small pelagic resources are exploited by small-scale gillnets and semi-industrial purse-seine in Côte d'Ivoire, Ghana, Togo and Benin and exclusively by small-scale fisheries in Nigeria and Cameroon. Coastal demersal resources are composed of sciaenids (exploited by small-scale and semi-industrial fisheries in Nigeria, Benin, Togo and Cameroon), groupers and snappers (fished in Togo and Ghana with hooks-and-lines in untrawlable areas), and sparids (Côte d'Ivoire and Ghana). The white shrimp resources off Nigeria and Cameroon are fished exclusively by artisanal fishery while pink shrimp is exploited by trawlers of the semi-industrial fishery. Penaeid shrimps in Togo and Benin and in Côte d'Ivoire are caught in lagoon fisheries. The offshore demersal resources of Ghana and Côte d'Ivoire are made up of sparids along with the slope community, while the offshore demersal resources of Nigeria and Cameroon are primarily drift fish and redfishes.

The recent biomass estimates of 7 000 t in Congo and 31 000 t in Gabon for stocks of Sciaenidae and Sparidae were based on acoustic surveys carried out in 1994. Demersal resources were either close to, or fully exploited. Effort reduction and redistribution would be beneficial, as fishing concentrates in the inshore zone and on juveniles. Small pelagic species (sardinellas, mackerels and anchovies) are important but unstable resources in the Western Gulf of Guinea (Côte d'Ivoire-Ghana-Togo-Benin) and their stocks are shared. Sardinella stocks seem to be in good shape. Substantial recruitment of *S. aurita* has been observed in Ghana and Benin in 1988 and 1989. The fishing pattern in recent years has been different from that of 1985 and 1987, with regard to the availability of the resources. Potential catches of small pelagics in the west and central Gulf of Guinea have been estimated at 330 000 t and are fully exploited. Little is known about pelagic and demersal resources in the whole southern Gulf of Guinea. Many countries have not developed an appropriate database and research structures to analyze stock exploitation status.

Acoustic surveys in the northern shelf of Angola indicated during 1985-1989 a decline in the biomass of small pelagics (sardinella and horse mackerel). The trend has dramatically reversed during the 1990s and the current biomass level now exceeds 500 000 t. Horse mackerel (*T. trecae*) biomass was estimated at about 250 000 t (1994). High biomass values for both round sardinella and Madeira sardinella were also recorded in the South Gabon - Congo

region, 135 000 t in 1994. Horse mackerel biomass was estimated at 25 000 t. These estimates indicate a considerable increase in biomass compared to previous survey results, confirming the trends observed in Angola. Small pelagic stocks are considered under-exploited.

Environmental changes manifesting a periodic variability in coastal upwelling intensities are playing a role in coastal pelagic fish abundance fluctuations.

5. MEDITERRANEAN AND BLACK SEA

FAO Statistical Area 37

INTRODUCTION

In this area (Figure B5.1) the Mediterranean system of basins includes semi-enclosed seas ranging from Atlantic water masses in the Western Mediterranean to slightly hypersaline warm-temperate water masses in the Levant basin, hyposaline waters in the Black Sea, and cold-temperate estuarine conditions in the boreal Azov Sea, in total, making up a large number of habitats with diverse stocks and species whose stock trends cannot be individually described here.

Figure B5.1

The fisheries of the Mediterranean have shown a surprising resistance to high fishing effort compared with, for instance, areas of the Atlantic, especially since formal and coordinated measures for fisheries management are largely absent in most countries.

PROFILE OF CATCHES

The total landings from the area have increased steadily since 1950, reaching 1.95 million tonnes in 1982 and remained around this level until peaking at 1.97 million tonnes in 1988. The subsequent sharp decline to 1.28 million tonnes in 1991 can mostly be attributed to the

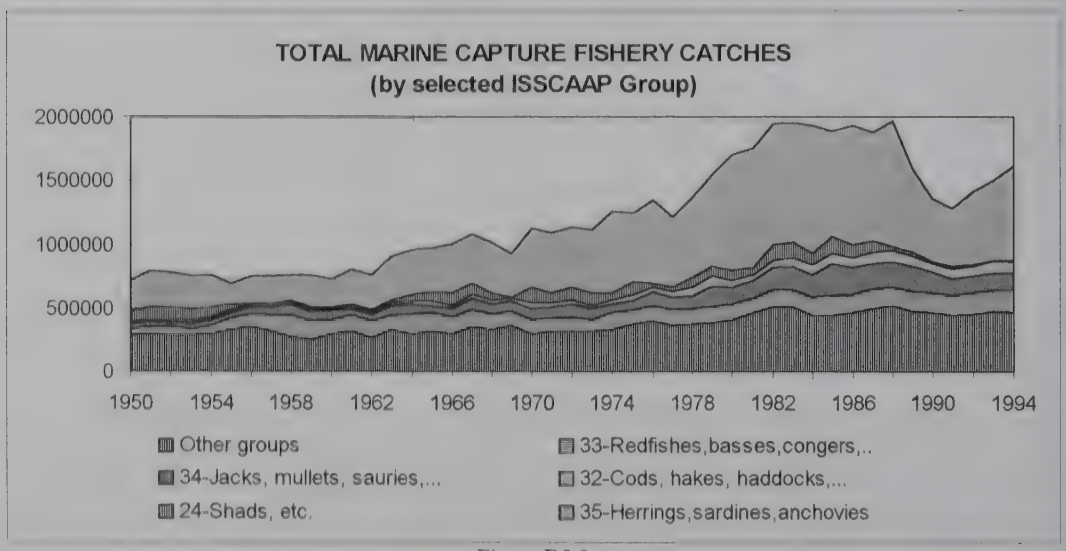


Figure B5.2

collapse of the Black Sea anchovy and sprat stocks. Other noticeable declines, such as that of the shads and sturgeons since the mid 1980s, have been caused by degradation in Black Sea estuarine environments, while the catches of major resources of the Mediterranean Sea continued to increase throughout this period.

The Mediterranean Sea is one of the few marine areas of the world's oceans showing a steady increase in production over the entire time series for all major resource categories. This increase in landings is in apparent contrast with a long and active tradition of fishing, large and seasonally increasing coastal populations, and long-standing high demand and prices for locally-caught fish. The strong demand for seafood and the long history of fishing have resulted in heavy fishing intensities over most shelf areas. This high fishing intensity, together with the generally narrow coastal shelves and vulnerability of the resources, would have led one to expect declining catches over most shelf areas, yet this had not occurred. While such characteristics might be interpreted as suggesting that stocks were underexploited in the early part of the time series, a number of dramatic ecological changes have taken place which make this conclusion erroneous. In fact it appears that the increase in production seen in the Mediterranean may represent, more so than for other areas, some index of overall stock changes.

The single major contributor by ISSCAAP Group are the pelagics of Group 35 (Figures B5.2 and B5.3). From a commercial perspective, in the Mediterranean proper these may be distinguished into anchovies and others, the former species commanding higher prices and having shown depletion of stocks in many areas. The second category (sardines, horse mackerel, sprat, etc.), plus the Black Sea anchovy, have, with local exceptions, commanded much lower prices and relative declines in market demand than demersals and invertebrates, the high diversity of which by far dominates the market value received from the fishery, especially in European markets. The recent collapse and recovery of anchovy catches in the Black Sea dominates the landing trend for this species throughout the basin, as does the similar trend for sprat.

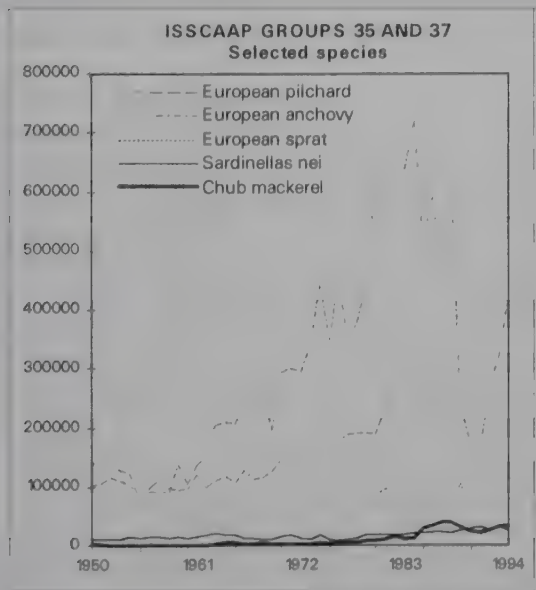


Figure B5.3

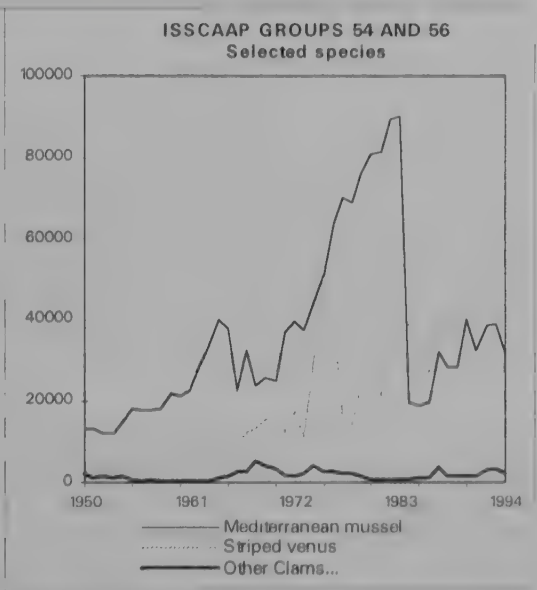


Figure B5.4

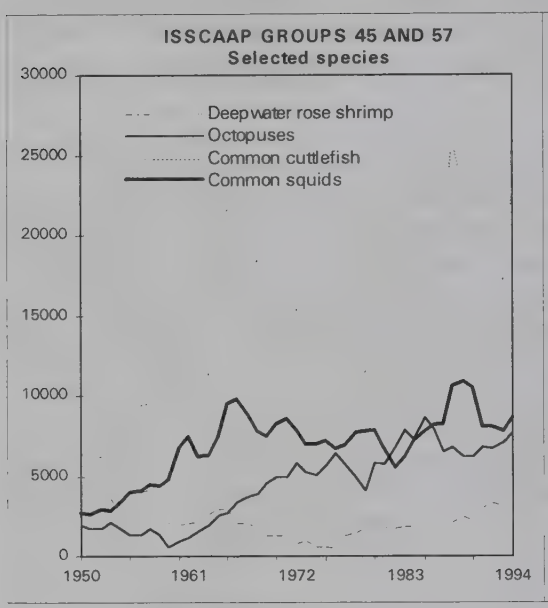


Figure B5.5

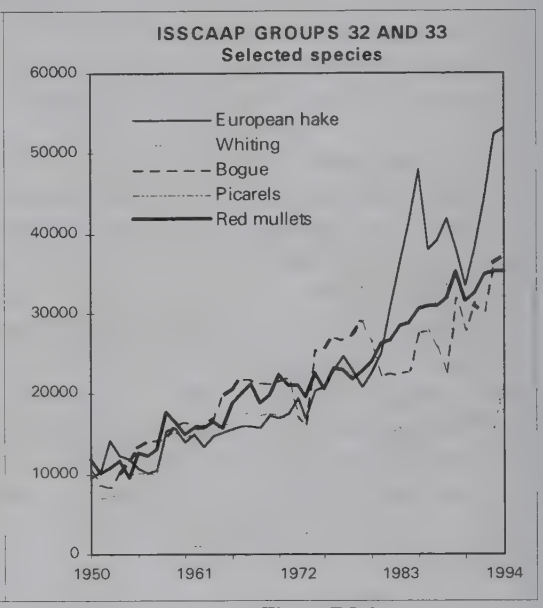


Figure B5.6

The high and growing share of invertebrates, especially molluscs, in the catches is noteworthy; particularly clams and blue mussels, as well as catches of octopus, cuttlefish and squids, which reached a plateau after 1988 (Figures B5.4 and B5.5). Among the demersals, hake and red mullet dominate, and have shown rises over the whole time series in most areas, as have a diverse mixture of small demersal fish (Figure B5.6). The collapse of demersal, shellfish and seaweed fisheries in the Black Sea, except for certain local areas, can be seen as a consequence of declines in oxygen levels in bottom water due to eutrophication, especially over the northwest shelf.

A recent Mediterranean phenomenon has been the dramatic increase in catches for large pelagics (Figure B5.7), which has been driven in the case of bluefin tuna by high prices. These high prices have attracted distant-water fleets as well as new technology, including large-scale drift nets and long lines also used by some coastal States, despite the ban of the former gear in international waters. Subsequent declines of some large pelagic species such as albacore remain unexplained. The lack of catches of bluefish and bonito in the northern Black Sea since 1970s is probably due to deteriorated environmental conditions.

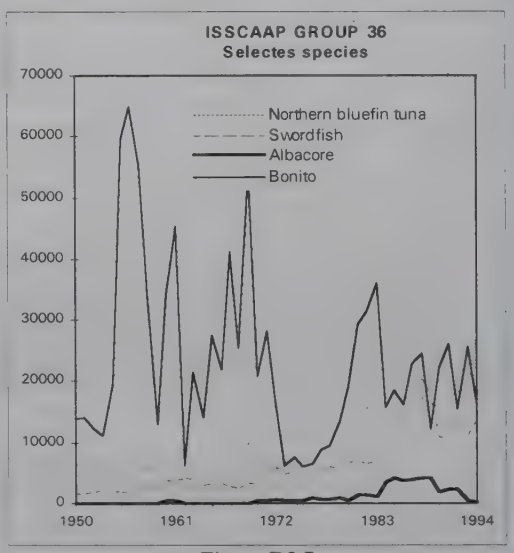


Figure B5.7

Catches of small coastal pelagics, e.g. silversides (Fig. B5.8), have increased in inshore areas but estuarine fisheries appear to have shown declines since the 1980s, especially shad and sturgeons in the Black and Azov Seas, the latter sustained mainly by hatchery production. Grey mullet catches have steadily risen

although with recent declines in individual Black Sea species.

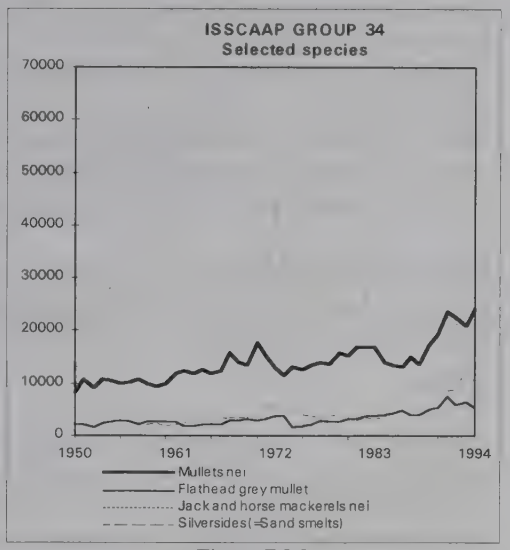


Figure B5.8

RESOURCE STATUS AND MANAGEMENT

The apparent anomaly between restricted shelf areas with high trawling intensity and a long-term rise in fisheries production, has prompted a search for major causative factors for the apparent resistance of the ensemble of stocks to the usual effects of heavy fishing. This was reported in previous reviews, in which the effects of nutrient runoff, a phenomenon general to all populated semi-enclosed seas, was highlighted. The hypothesis of nutrient limitation to Mediterranean fisheries ecosystems seems to receive confirmation from historical fishery production per shelf area data which unlike that for almost all other FAO Statistical areas, has continued to slowly increase throughout the time series in the record.

In 1969, production was much below the world average of 3.4 t/km^2 of shelf area within 200 nm quoted by J.A. Gulland in 1971, ranging from 2.4-3.4 for the Western Mediterranean closest to the Atlantic inflow, to 0.5-0.6t/km^2 for the Ionian, Aegean and Levant, in areas then regarded as among the most nutrient-limited inland seas. By 1989, fishery production figures had increased and varied from 5.25-6.43 t/km^2 for the Balearic and Gulf of Lions and 4.78 and 8.15t/km^2 for the now eutrophic Black and Marmara Seas. Meanwhile, fishery production in the formerly nutrient-poor areas of the Ionian, Aegean and Levant had risen to 1.42, 2.20 and 1.56t/km^2 respectively. Similar trends are shown by demersal and shellfish production, which are of course more closely tied to the shelf area. The Sardinia Statistical Division is the only one to have shown a drop in production per shelf area.

It seems difficult to explain these geographical and temporal changes as a consequence of fishing intensity alone, which was already high in the 1970s. The suggestion is that shelf areas now receive higher levels of nutrients, notably from river runoff in the Northern basins, and that primary production, and its contribution to food webs supporting fishery production, has increased. Dramatic increases in production of plankton and detritus feeders are shown through the sharp rise in Mediterranean mussel, clam and other molluscan production over the last decades. Bottom invertebrates also contribute to food requirements of demersal fish such as the red mullets, soles, grey mullets, seabream and red porgy, all of whose landings have risen steadily over 4 decades (similar increases in landings of gilthead seabream probably in part reflect increased cage culture of this species).

The fact that these fisheries still apparently support high levels of landings in many areas despite high fishing pressure by small mesh trawlers on narrow shelves, is also a subject worthy of further study. Earlier fisheries studies carried out by member countries of the General Fisheries Council for the Mediterranean (GFCM), plus the relatively limited stock assessments performed in the Mediterranean since, suggest that a high fishing pressure has existed, at least in the northern Mediterranean, for several decades. This conclusion appears to be supported

by the increased share of short-lived species such as cephalopods, shrimp, and other benthic crustaceans in the landings over the last few decades. Increased recruitment, possibly accompanied by declines in larger predators, may be among the causative factors here.

Landings of some predominantly inshore demersal species such as the red pandora, pouting, silversides (Table V and Figure B5.8) may represent a growing inshore artisanal and sports fishing pressure with improved gear that is still not properly documented.

The serious decline in landings of the extremely valuable red coral and spiny lobster resources from the deeper shelf and slope, and valuable sponges whose stocks in the southern and eastern Mediterranean were decimated by disease in the 1980s may also reflect ecological changes.

The increase in slope fisheries, especially for the blue and red shrimp and hake over the last few decades, should be viewed with a certain degree of apprehension. The traditional fisheries for hake have used small mesh trawls in inshore areas and targeted 0+ to 2-year-old age groups. The fisheries for hake by other gear in deeper waters are now targeting concentrations of mature fish. Increased offshore fisheries on mature fish is cause for concern because a possible explanatory hypothesis for the continued productivity of demersal stocks is that a small proportion of the 0+ to 2-year-old age groups escape from the inshore areas and form a 'refugium' or spawning escapement in offshore waters. This hypothesis appears to receive support from selectivity studies, which suggest that larger fish such as big hake are less available to capture in small mesh trawls than small fish.

It seems that fishery statistics, for all their deficiencies, provide almost the only long-term biological data source for this ecosystem. These statistics are painting a picture of rapid ecological change within the Mediterranean basins that may apply elsewhere in semi-enclosed and coastal seas. Such ecological changes are a result not only of fishing, but of other activities within adjacent land masses, particularly those which influence the runoff of nutrients.

One other dramatic series of ecological changes relating to species introductions has been mentioned for the Black Sea, where introduction of a number of noxious species, both phytoplankton and animals, has occurred through cargo ship ballast water. Possibly, a similar mechanism is responsible for the growing number of Red Sea species entering the eastern Mediterranean through the Suez Canal (Lessepian migrants), and subsequently moving northwards and westwards (Figure B5.9). The dramatic accidental introduction and spread of a toxic species of seaweed *(Caulerpa toxifolia)* into the western Mediterranean, is also likely to affect demersal food chains in that area in a manner which is not easily predicted.

The Azov and Black Seas

In the Azov Sea several stock collapses of freshwater fish stocks occurred in the 1960s (pike, bream, roach), and were associated with progressive salination of this habitat due to damming of, and water extraction from, major inflowing rivers: as a result, the salinity of the Azov increased by several parts per thousand. This, plus impacts on spawning routes and spawning areas in the main rivers, has seriously affected natural sturgeon populations, whose catches are now in part maintained by hatchery production. Declines of demersal fish stocks (most importantly turbot), benthic crustaceans, and zoo- and phyto-benthos such as mussels and red

algae (which, formerly played a major role, respectively, in filtering and oxygenation of shelf water) occurred in the Northwest Black Sea. These were largely due to anoxic events caused by a greatly increased planktonic production, which, in turn, was linked to nutrient inputs from the large Black Sea catchment basin. Collapses of stocks of the Azov Sea sprat, and in the Black Sea, the anchovy, Mediterranean horse mackerel, and sprat stocks in the late 1980s, were almost certainly linked to the introduction to the Black Sea and Azov of the west Atlantic ctenophore *Mnemiopsis leidyi*.

Accumulative number of recorded finfish species from the eastern Levant. Shaded area indicates Lessepian migrants from the Red Sea

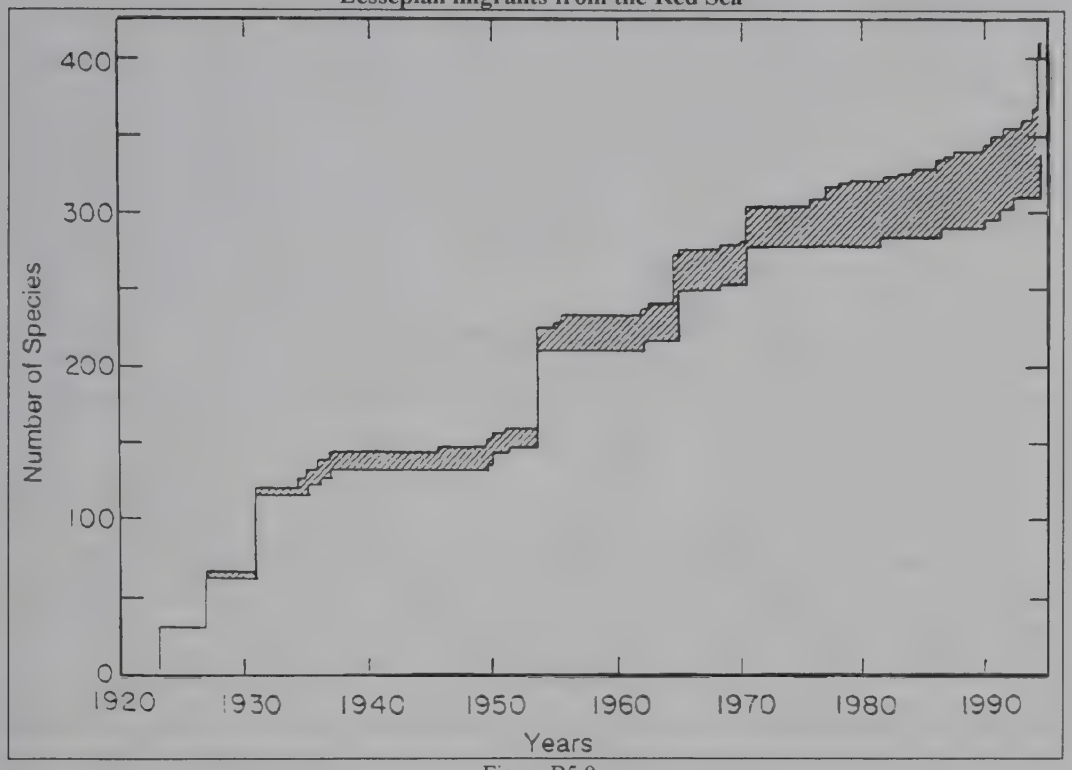


Figure B5.9

Top predators such as dolphins have seriously declined in abundance. Predatory fish, including mackerel, blue fish and bonito which used to seasonally enter from the Sea of Marmara (also subject to heavy pollution and fishing), now rarely penetrate into the waters to the north and west of the Black Sea. Stocks of these species can be considered depleted, although (as for a number of other stocks) not necessarily by fishing alone.

Meanwhile, a species of grey mullet (the haarder introduced from the Pacific coast of Russia), a detritus feeder which breeds in shallow water, appears immune to *Mnemiopsis* predation on its larval stages, and has increased in stock size. Several other introduced species appear pre-adapted to eutrophic conditions, such as the *Mya* clam and *Rapana* sea snail, the latter now being a major export item in some countries, and can be considered fully exploited. (See Table B5.1.)

TABLE B5.1: STATUS OF STOCKS OF KEY BLACK SEA FISHERIES

The following general consideration and recommendations have been suggested for serious joint consideration by Black Sea Countries

Resource categories	State of stocks	Ecological/environmental controls	Fisheries management measures	Operational targets
Small pelagic fish	Believed that stock size of most small pelagics has partially recovered from *Mnemiopsis*-caused depletion which began in the early nineties.	Consider feasibility of keeping *Mnemiopsis* biomass in check by keeping planktivore biomass high, especially for horse mackerel, believed to be predator on *Mnemiopsis*. Important to reduce eutrophication of Black Sea, and hence reduce competitiveness of *Mnemiopsis*.	There is an urgent need to decide on a common method of control of fleet size and catch and decide on access, national allocations of catches and fishing opportunities.	In the absence of a fully operational Black Sea Fisheries Commission, the countries of the region should seek to agree on stock assessments and allocations. They should meet annually to discuss coordinated plans for fishing and for research surveys. A system of arbitration of disputes will be required.
Sprat	Have remained high, especially in NW Black Sea.	As above.	Could allow some moderate expansion of fisheries for human food.	See above considerations for use of fish for food and licence limitation. Agreement on level of catch should be made between national authorities after cooperative acoustic survey and annual meeting of assessment scientists. Assistance with regular fishery survey activities of national fleets.
Whiting	Ditto.	Careful to avoid over-fishing of a key prey species for predators such as turbot.	Ditto (by-catch in sprat fishery as well as directed fisheries).	Ditto.
Anchovy	Some stock recovery, but restricted by uncontrolled exploitation. (Evidence of some profound changes in age at maturity and area of spawning as a result of *Mnemiopsis*).	As for general comments.	Negotiate internationally and introduce catch or trip limits on national level.	Ditto. (Aim at increasing stock size and reduce exploitation rate to achieve age composition comparable to early eighties, with more older fish in the stock). Training of fisheries assessment and management personnel.
Horse mackerel	Some recovery?	Predator on *Mnemiopsis*?	Allow only incidental catches.	Ditto. Aim at doubling stock size by 2005.
Resource categories	State of stocks	Ecological/environmental controls	Fisheries management measures	Operational targets
Turbot	Declining to seriously depleted levels.	Environmental conditions of shelf waters restrict stock recovery.	Essential to decide on national fishing zones.	An agreement on joint policing of fishing management measures for turbot should be approached.
			Priority to recreational/hook-and-line fisheries. Consider banning in most areas of trawls and gill nets.	Consider feasibility of closed fishing areas where young fish are predominant. (Feasibility study and advice on management of fishery closed areas, location and policing in each country.)
Spiny dogfish	Slow decline in stocks in most areas.	Species relatively immune to *Mnemiopsis*.	Fishing effort not to exceed current levels. Take into account migrations in allocating catches.	A regular coordination of fishing plans between the countries concerned is strongly recommended. (Advice on preparing a coordinated fishery management plan for a 'pilot resource' is proposed for this species, involving national and international consultants and one meeting). Aim at doubling biomass by 2000 through appropriate joint management measures.

Perhaps the most dramatic change in the last few years has been the partial recovery of the anchovy stock, which has occurred in part due to the decline of fisheries in the North and West of the Black Sea. This recovery was partly due to the inability of fleets to fish in the formerly important grounds in the northeast of the Black Sea now within Georgian waters, and probably due to the change in target for the fishery towards waters in the southern Black Sea and to 0+ age groups. In combination, a major selection pressure has been exerted on this stock, which is showing impressive signs of adaptation of anchovy to the exotic planktonic predator mentioned above.

Despite the anchovy collapse and partial recovery, it would be misleading to consider this stock underexploited. Except for the fleets of the former socialist countries, which are undergoing an uncertain process of reconstruction hampered by shortage of funds for repair and investment, the former excessive levels of overcapitalization of the fishing industry mentioned in the last review still exist in the southern Black Sea. By contrast, the stocks of sprat and several other species in the Northern Black Sea may now be underexploited for reasons suggested earlier. The remaining demersal resources should be allowed to rebuild where possible, requiring serious management measures to be adopted by the countries involved.

The reduction of fertilizer use within the huge Black Sea catchment area in the years following movement to a market economy on the part of countries in transition may also have played a part in the recent gradual improvement in water quality of inflowing water from the Danube river.

The Mediterranean

Steep increases of catches of planktivorous species all seem to imply dramatic ecological changes over the last decade. These species include: sardines, especially in the northern Mediterranean; sardinellas in the south; new fisheries for the largely pelagic blotched picarel registered in Tunisia and for bogue, and for near-shore stocks of silversides in the eastern Mediterranean. These changes are not all due to increased fishing pressure but are almost certainly in part due to increased nutrient inputs to a formerly low nutrient sea, as implied by remote sensing imagery, showing high chlorophyll concentrations in the northern Mediterranean. Most of these small pelagic species show wide fluctuations in abundance, and few examples of a species showing steady levels of landings are evident in the Mediterranean data base of landings. Other than anchovy, which has high value and has declined in a number of areas, most small pelagics can be considered moderately to underexploited, due to a generally low market demand.

Steep increases in the catches of predators on small pelagic fish species such as the mackerels, dolphin fish, carangids, amberjack, chub mackerel and swordfish over the last two decades certainly reflect a greater interest in offshore resources, many of which are probably now approaching full exploitation. This increase may also be a consequence of increased food availability of forage fish, as mentioned above, and does not necessarily imply that they were formerly being fished at rates below those that would correspond to full exploitation under stable ecological conditions. Similar increases in landings, (and similar conclusions) apply to demersal predators such as hake, anglerfish, whiting, conger eel and some *Dentex* stocks, and for a number of these stocks assessments confirm a general state of full exploitation.

Concern has rightly been expressed about the stock status of bluefin tuna and swordfish. In both cases the (apparently unrestrained) growth of surface gill net and long line fisheries over the last decade has increased vulnerability of these stocks as has regular fishing by non-coastal States on bluefin stocks. The bluefin tunas, which are regarded as belonging to a common stock in the eastern Atlantic and Mediterranean, are seriously depleted with respect to the earlier historical record. For this latter species, the GFCM has adopted recently the regulations on bluefin fisheries from the International Commission for the Conservation of Atlantic Tunas (ICCAT), to apply to all member countries of GFCM for swordfish and bluefin tunas. In the case of swordfish, as noted, steady increases in landings may reflect in part increased availability of pelagic forage species but also surely reflect a seriously high level of exploitation, also reflected in progressive decreases in mean size and age at capture.

Some pelagic resources which have not reacted positively to fishing or ecological changes over the last few years are the little tunny, Mediterranean horse mackerel and scombrid stocks. The stocks of a number of important elasmobranch species have collapsed, testifying to the fragility now generally recognized for these low fecundity resources.

6. SOUTHWEST ATLANTIC

FAO Statistical Area 41

INTRODUCTION

This Statistical Area covers a total area of 17.62 million km^2 off the eastern South American coast, from northern Brazil to southern Argentina and includes a total shelf area of 1.96 million km^2. In the Amazon area the continental (Figure B6.1) shelf may extend as far as 65 km (35 nm) offshore where the bottom is mostly river deposits and debris, but otherwise the shelf in the northern part is rather narrow and coraline and mostly unsuitable for trawling. The shelf continues to be narrow and rocky off central and southern Brazil, before getting wider and more easily trawlable as higher latitudes are approached. The best and largest trawling areas are found in the River Plate area and over the Patagonian shelf and the Falkland-Malvinas area, where the shelf extends well beyond the 200 nm limit (more than 370 km) off the continental coastline, turning this into the largest shelf area in the southern hemisphere.

Figure B6.1

The type of fisheries and the variety and abundance of exploited fishery resources within this area are determined by the topography and other physical characteristics, including the

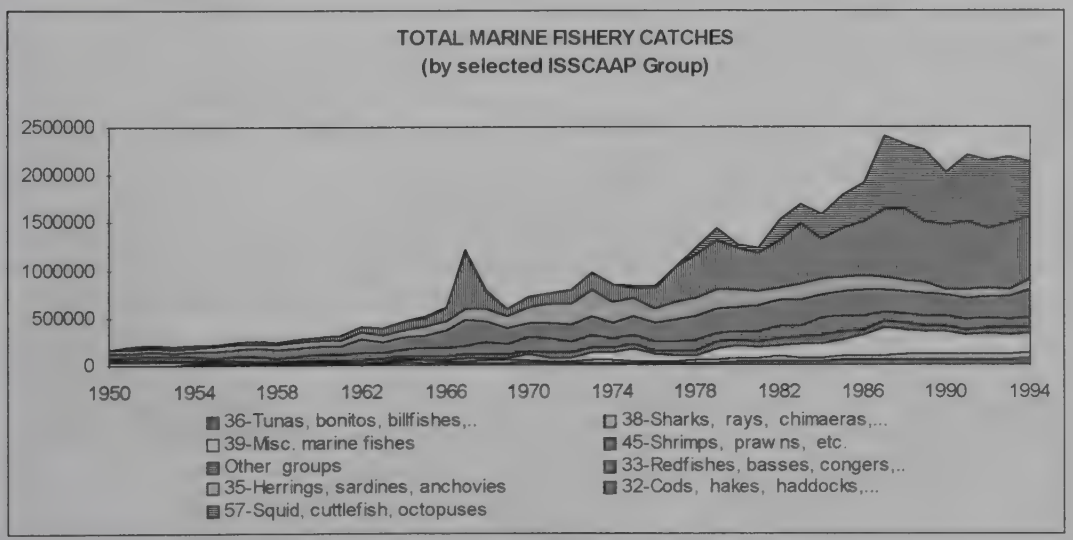


Figure B6.2

differences in environmental conditions, which range from typically tropical in the north to sub-Antarctic in the south. Shrimps and lobsters, and to a lesser extent reef fishes and other tropical demersals, tend to be of particular relevance towards the northern part of the area. Small pelagics sustain an important fishery in nutrient-rich coastal areas where water masses mix off central Brazil and are also abundant in the River Plate area. Coastal demersals are particularly important off southern Brazil and in the River Plate area, while mid- and deep-water demersals tend to dominate the scene over most of the River Plate, the Patagonian and Falklands-Malvinas shelf area, where there is also an important squid fishery. Large pelagics are mostly caught off central Brazil and the River Plate area.

PROFILE OF CATCHES

Total fish production in this area comes mostly from demersals, and more recently from squids, mainly caught in the southern Patagonian shelf area. This is one of the Statistical Areas where capture fisheries have seen a rapid development in terms of total production, with a more or less sustained rate of increase in recent years. In 1950, when most known fish stocks in the area were reported as lightly exploited or virtually unexploited, the total catch for the whole area was only 170 000 t. Several new fisheries have developed since, and total catches have increased consistently at an average rate of 9% per year, to reach a maximum of 2.4 million t in 1987. Then total catches level off, to decline slightly to 2.1 million t in 1994. Except for the burst in catches in 1967 caused by an intense pulse fishing of hake and other demersals by an ex-USSR fleet, total annual catches by year and major ISSCAAP group increased almost steadily between 1950 and 1987, to decline with some year-to-year fluctuations toward 1994 (Figure B6.2 and Table VI).

At the ISSCAAP Group level, the major contributors to the total catches are the demersals in Group 32 (cods, hakes, etc.) and molluscs in Group 57 (squids, etc.), followed by the demersals in Group 33 (redfishes, basses, congers, etc.), the small pelagics in Group 35 (herrings, sardines, anchovies, etc.), and other demersals in Group 38 (sharks, rays, chimaeras, etc.). At the single species group level, the dominant species in terms of volume are the Argentine hake (*Merluccius hubsii*) and the southern blue whiting (*Micromesistius australis*) in the demersals ISSCAAP Group 32, the Argentine shortfin squid (*Illex argentinus*) in ISSCAAP Group 57, and the Brazilian sardinella (*Sardinella brasiliensis*) in the small pelagic ISSCAAP Group 35.

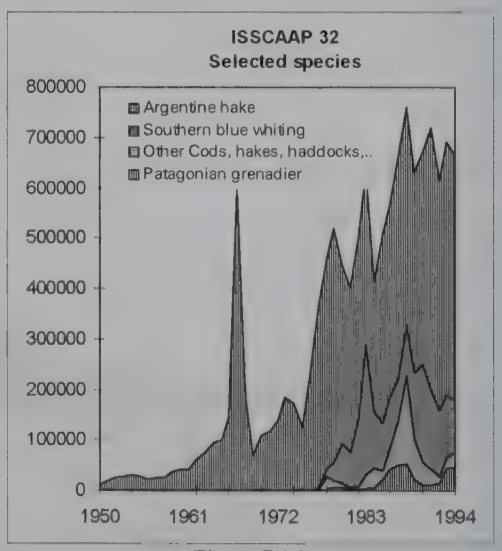


Figure B6.3

The Argentine hake (*Merluccius hubsii*) sustains one of the most important fisheries in the River Plate area and over most of the Patagonian shelf. After reaching a maximum of 520 000 t in 1991, annual catches of this species leveled off and are now diminishing slightly (Fig. B6.3). However, it is still the main single species with the highest catches in the area. Other deep-water demersals in the ISSCAAP Group 32 which make a significant contribution to the total catches in the area are the southern blue whiting (*Micromesistius australis*) and the Patagonian

grenadier (*Macruronus magellanicus*) (Fig. B6.3). These are particularly abundant in the Southern Patagonian shelf and slope area, where they are exploited by long range fleets from the region as well as from distant areas.

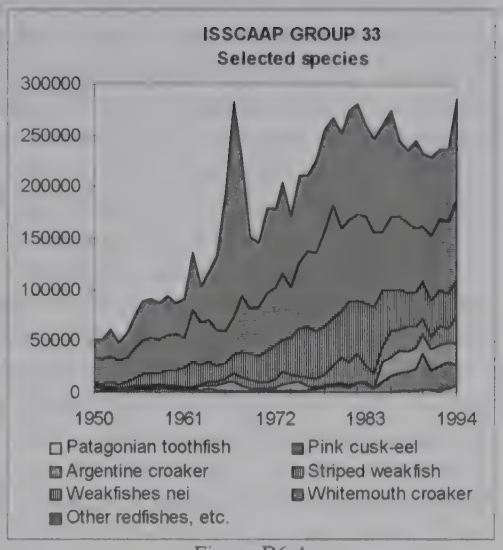


Figure B6.4

Other deep-water demersals in ISSCAAP Group 33 (Fig. B6.4) that contribute with a large share of the total fish production in this area are the pink cusk eel (*Genypterus blacodes*) and Patagonian toothfish (*Dissostichus eleginoides*), that reported catches of 21 000 t and 6 000 t respectively in 1994. Within ISSCAAP Group 33 there are also some coastal demersals that produce significant catches within the area. These are the white mouth croaker (*Micropogonias furnieri*), the Argentine croaker (*Umbrina canosai*) and the weakfishes (*Cynoscion spp.*) which have reported relatively high and stable catches over the past few years.

The main species within ISSCAAP Group 35 are the Brazilian sardinella and the Argentine anchoita. Catches of tunas and other large pelagics in ISSCAAP Group 36 (Fig. B6.5) are increasing slowly in the area (Figure B6.5).

Another very important fishery in this area is that for squids, mostly Argentine shortfin squid (*Illex argentinus*) and common squid (*Loligo* sp.). The overall abundance and actual catches of these species have been very variable since the fisheries started some 10-15 years ago, and after reaching a maximum of 760 000 in 1989 total catches have declined to 560 000 t in 1994 (Table VI).

Within ISSCAAP Group 45, it is noteworthy that shrimps, prawns, lobsters and crabs sustain important fisheries in the whole area, from the tropical to the sub-Antarctic zone. Altogether this species group has been yielding total catches of almost 100 000 t per year, an important figure considering their high market value. In most cases these stocks are considered to be fully to over-exploited.

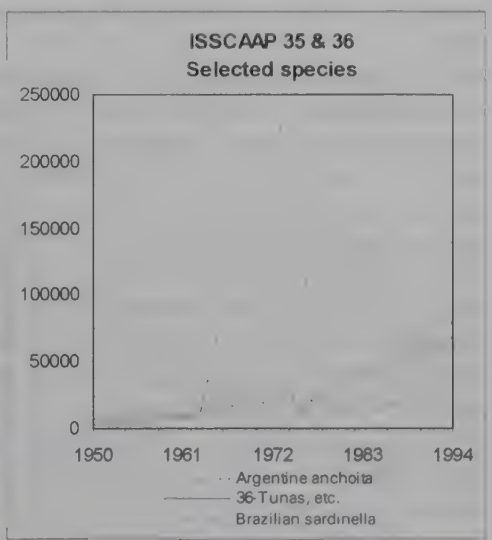


Figure B6.5

Also noteworthy is that around 10% of the total catches in this Area are reported as unidentified fish, or "marine fishes nei" in the official statistics, grouped here under ISSCAAP Group 39 (miscellaneous marine fishes) in Figure B6.2 and Table VI. While this lack of accuracy in the reporting of catch statistics by species is not as serious as in other less-developed areas, it is still an indication of weaknesses in the species identification and catch-reporting systems at

national level and of difficulties and uncertainties regarding the assessment and management of some fisheries and fish stocks in the area. Reported catches in ISSCAAP Group 39 have been increasing slightly, following the same general trend as the other, better identified species groups. In 1994 the total catch in this category amounted to 210 000 t, of which more than 190 000 t were reported by Brazil, followed by Rep. of Korea and Uruguay.

There is also some reporting of non-identified species within the other ISSCAAP Groups, and of particular relevance are the reported catches of unidentified squids (squids nei) in ISSCAAP Group 57. In some years this group accounted for more than 50% of the total squid catches in the area, while in 1994 the reported catches of unidentified squids added 257 000 t, out of a total of 563 000 t for the whole squid group. These catches were reported mainly by Japan, Rep. of Korea, Russian Fed., Spain and Lithuania. Most, if not all, of these unidentified squid catches are believed to be either the Argentinean shortfin squid (*Illex argentinus*) or the common squid (*Loligo sp.*). Most of the catches of unidentified fish from Brazil and Uruguay seem to come from poorly monitored coastal small-scale fisheries, while those by distant-water countries come from long range industrial fleets.

Prior to the 1970s, most of the catches in this area were reported by coastal states, with no more than 2% of the total being caught by long range fleets from other nations. This changed, and temporarily increased to more than 60% in 1967 during the short-term pulse fishing exerted by the ex-USSR. The proportion taken by long-range foreign fleets then started to increase steadily from 5% in 1972 to 50% in 1987, to then drop to 28% in 1994. Most of these catches by nations from outside the region are deep-water demersals and squids taken in the southern Patagonian shelf area or tunas taken elsewhere.

RESOURCES STATUS AND MANAGEMENT

Until the early 1980s this area was amongst the few major fishing areas of the world with a large potential for expansion, with a few stocks still falling under the general category of underexploited or lightly exploited stocks. Several mostly industrialized long-range fisheries have develop since, and most of the fish stocks are now considered to be fully exploited, while some are, or have been, overexploited during the past few years.

While there is a growing concern over the state of exploitation of some fish stocks, the amount of updated hard evidence on the assessment and management of fish stocks and fisheries for the area seems to have diminished in recent years. To a great extent this has to do with the slowing down in the activities of organizations or working groups that either directly, or through scientific or technical meetings and publications, used to look into and report on stock assessment and fisheries management-related issues in the area.

The Joint Technical Commission for the River Plate Maritime Front ("Frente Maritimo"), based in Montevideo, Uruguay, has been very active in promoting bilateral cooperation between neighboring Argentina and Uruguay regarding the assessment and management of shared fish stocks and in promoting scientific meetings and publications of regional and international relevance, where various stock assessment and fisheries management issues used to be addressed and discussed. Due to various reasons, most of these activities have been suspended or reduced in recent years.

Argentina and the United Kingdom are also co-operating in the assessment and management of fish stocks and fisheries in the Falklands-Malvinas area, and this has resulted in the adoption of some coordinated management measures to restrict access and regulate fishing effort in neighboring fishing grounds, including voluntary restrictions in fishing grounds located beyond the 200-mile limit. While it is known that fisheries in the area are closely monitored and assessed, sometimes at a bilateral level, the results of these assessments are however not readily available outside specific bilateral meetings.

Brazil also used to have some 10 permanent working groups that were responsible for providing advice on the management and development of fisheries along the Brazilian coast, but they have been inactive in recent years. Some fruitful results have, however, been achieved, and contributed to improve the assessment and management of shrimp resources in the northernmost part of Area 41, in the Guyana-Brazil area, within the context of the Western Central Atlantic Fisheries Commission (WECAFC).

As mentioned above, most of the reported expansion in production in this area is due to the increased catches of hake and, more recently, of other demersals and squids caught in the Patagonian shelf and slope area. The available assessments and information on exploitation rates indicate that the Argentine hake stock is fully exploited and probably has been slightly overexploited during some years. The fishing grounds of Argentinian hake overlap over the outer Patagonian shelf and slope with that of the Patagonian hake (*Merluccius polylepis*), from which it can hardly be distinguished from simple observation in the commercial catches. It is therefore believed that a small portion of catches reported as Argentinian hake are actually of Patagonian hake, which is probably in the same state of exploitation as the former

The stocks of the other major ISSCAAP Group 32 species, Southern blue whiting and the Patagonian grenadier, are moderately to fully exploited and annual catches have been slightly variable, apparently due to changes in availability and shifts in fishing pressure. In 1994 the total catch of these two species was, respectively, 105 000 t and 46 000 t.

The stocks of the main deep-water demersal species within ISSCAAP Group 33 (pink cusk eel and Patagonian toothfish) are considered to be moderately exploited. There are several stocks of the coastal demersal species of Group 33 throughout the region, and most of them seem to be moderately to fully exploited, with some local stocks probably overexploited. In 1994 the catch of the three main coastal demersals (whitemouth croaker, Argentine croaker and weakfishes) was 78 000 t, 21 000 t and 61 000 t respectively. These stocks are mostly exploited by Brazil, Argentina and Uruguay.

The Brazilian sardinella (*Sardinella brasiliensis*) of ISSCAAP Group 35 has been overfished for several years and has also been affected by some adverse environmental conditions. After being in the range of 120 000 t to 230 000 t per year, catches declined to 32 000 t by 1990. Although catches have recovered to 85 000 t in 1994, the stock still seems to be in poor condition. In the same general area, but further south, off Uruguay and Argentina, the Argentine anchoita (*Engraulis anchoita*) is one of the few cases left of an underexploited stock. While catches of this species have been stable in the order of 20 000 t per year, available estimates suggest a potential several times higher.

The total catch of tunas (ISSCAAP Group 36) was 70 000 t in 1994, and although there are no specific assessments of the state of these stocks, there might still be some room for further

expansion. Catches of sharks and rays have also been increasing slightly, to almost 55 000 t in 1994. No assessments are available for these stocks in this area either. The main stocks of squid are found on the Patagonian shelf and slope area and are exploited by long range fleets from different nationalities. They are most likely fully to over-exploited.

While enforcement is not always as effective as desirable, most of these fisheries are under some kind of management scheme, with specific management measures that vary from one country to country and from one stock to another. Only a few fisheries are under an open access regime, and these are mostly coastal small-scale fisheries. In most cases there is some kind of limited access scheme, often combined with nominal fishing effort and/or total allowable catch (TAC) limits to keep fishing mortality under control, and minimum size limits or seasonal closures to protect juveniles and spawners. The hake fishery is regulated by an annual TAC, and minimum mesh size limits are in force to keep the capture of juveniles down. Some incidence of discards has however been reported and seems to be a problem that needs to be addressed. Similar management measures are adopted for other demersals, while squids are mostly managed through annual fishing licences and TACs geared to ensure a minimum escapement each year. Shrimps, lobsters and other crustacean fisheries are mostly regulated by closed seasons and areas and minimum size limits.

7. SOUTHEAST ATLANTIC

FAO Statistical Area 47

INTRODUCTION

This section deals with the three countries with coastlines on the Southeast Atlantic (Figure B7.1): Angola, Namibia and South Africa. Included in the catches of the last-named are some taken from the western Indian Ocean. However, discounting the Agulhas Bank, which is now considered a part of the Benguela upwelling system, these landings form a very small part of the total for the region. The rest of the region is dominated by the Benguela upwelling system which, through the injection of cold nutrient-rich water into the surface waters, supports relatively high production along much of the coastline of these three countries. The northern border of the Benguela upwelling system occurs at the marked thermal front with the warm Angola Current, between about 15°S and 17°S in southern Angola.

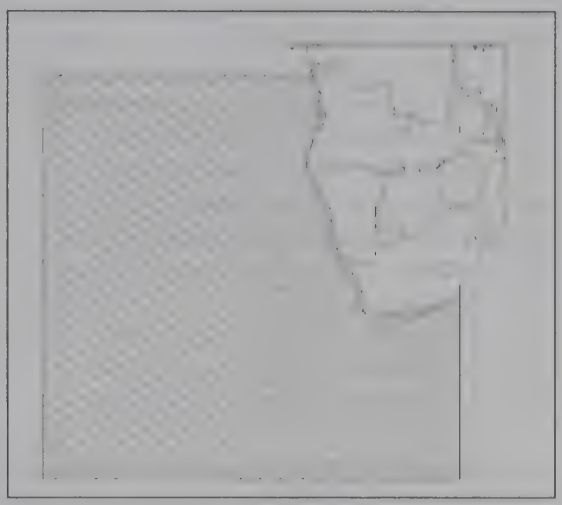


Figure B7.1

This area is marked by productive and well established fisheries that have a general history of good management in recent decades after periods of over-exploitation, particularly in the 1950s and 1960s. Despite the level of management intervention, however, a number of fisheries are in a tenuous state, apparently largely because of environmental influences. The

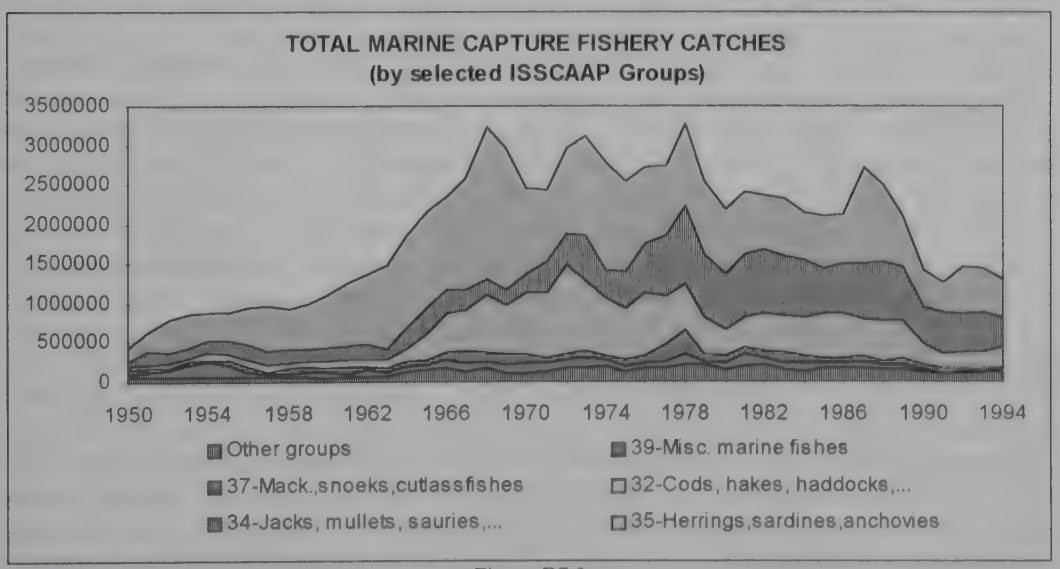


Figure B7.2

pelagic fisheries in the region are being affected by declines in sardine abundance in the north and anchovy abundance in the south, while the trawl fishery in Namibia and Angola is being affected by a decline in hake abundance in their waters. Research activities in this area are mainly undertaken by the Instituto de Investigacao Pesqueira, Angola, the National Marine Information and Research Centre, Namibia and the Sea Fisheries Research Institute, South Africa, who are thanked for providing invaluable data and information for this section.

PROFILE OF CATCHES

Total catches from the region increased rapidly in the 1950s and 1960s, primarily due to fishing by distant-water fleets. Since the early 1960s the pattern in total catches has been almost entirely due to catches of species within ISSCAAP Groups 32, 34 and 35 (Figure B7.2). The total catch declined in the late 1980s and subsequently fluctuated around 1.4 million tonnes in the early 1990s. The largest national landings in 1994 were made by South Africa, with a total catch of over half a million tonnes, followed by Namibia (300 000 t) and Angola (71 000 t, Table B7.1). However, some foreign fishing also takes place in Namibian and Angolan waters and, for example, in 1994 nearly 230 000 t of Cape horse mackerel was caught, mainly by the Russian Federation, Ukraine and Estonia, as well as approximately 30 000 t of Cape hakes *Merluccius paradoxus* and *M. capensis*, mainly by Spain.

Landings made by the fisheries of Angola, Namibia and South Africa in 1994, in '000 t

Country	Marine Fishes	Crustaceans	Molluscs	Total
Angola	69	2	0	71
Namibia	300	0	0	300
South Africa	507	2	10	519
Total	876	4	10	890

The pelagic fisheries in the area are dominated by the Southern African pilchard and anchovy (Figure B7.3), with catches of Whitehead's round herring having been the third most abundant species in recent years (Table VII). *Sardinella spp* are caught mainly in Angolan waters. These species all fall into ISSCAAP Group 35, which accounted for the highest mass of landings in the fisheries of this region in 1994 (Table VII). Catches by the pelagic fisheries of the sub-region, generally making use of purse-seine nets, were dominated by the Southern African pilchard until the early 1970s, when over-fishing, probably coupled with adverse environmental conditions, caused a drastic decline in abundance. Hence, anchovy were caught in increasing numbers during this period of sardine decline, particularly in the southern parts of the sub-region, and thereafter became the dominant species in the South African pelagic fishery. In recent years, however, the pilchard has shown encouraging increases, while anchovy has been highly variable but with an overall decline in landings since 1988.

The ISSCAAP Group contributing the second highest landings, by weight, from the region in 1994 was group 34 (Jacks, mullets, sauries, etc.). Landings of species within this group amounted to nearly 400 000 t in 1994. Of this, over 280 000 t was Cape horse mackerel and another 100 000 t of Cunene horse mackerel. The Russian Federation recorded the bulk of these landings, accounting for 50% and 70% of the Cape and Cunene horse mackerel landings respectively. Of the countries within the region, Namibia landed the most Cape horse mackerel (34 000 t) and Angola the most Cunene horse mackerel (29 000 t). Cape horse mackerel landings increased rapidly in the 1970s (Figure B7.4), probably as a result of a

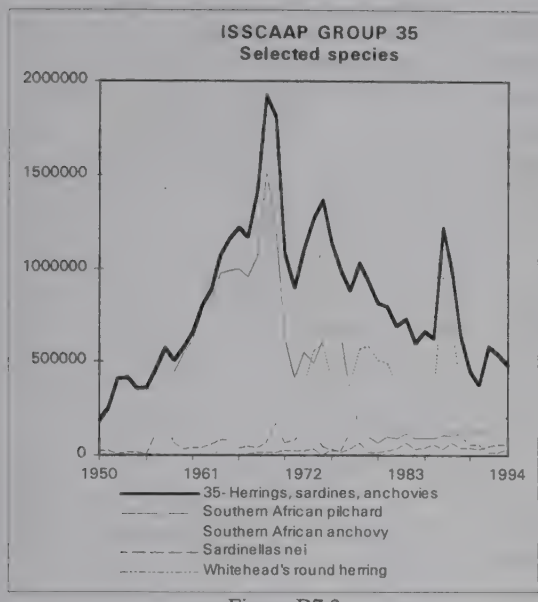


Figure B7.3

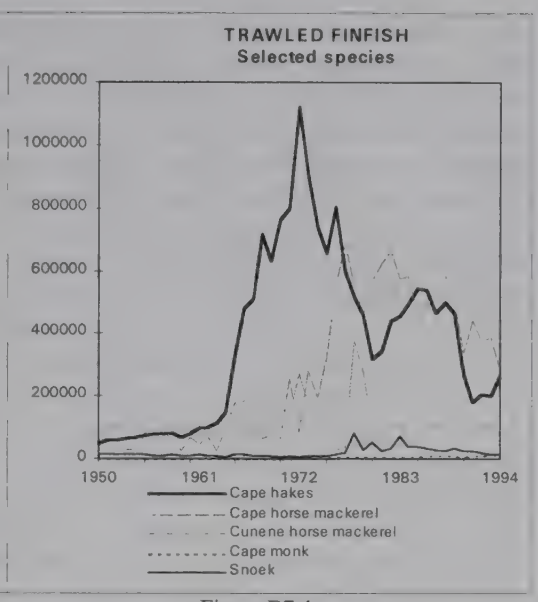


Figure B7.4

redirection of effort in response to declining landings of hakes and sardine, possibly associated with the entry of several strong year classes into the population. Landings have subsequently shown a general decline since the early 1980s, while those of Cunene horse mackerel have been variable but not shown a sustained increase or decrease over the same period.

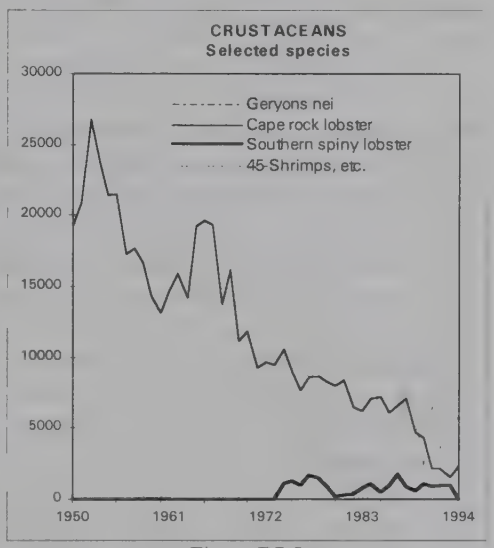


Figure B7.5

The third highest landings in the region in 1994 came from ISSCAAP Group 32 (Cods, hakes, haddocks, etc.) with landings of approximately 266 000 t. Within this group, Cape hakes accounted for the highest catch mass from the fisheries of the sub-region, with a total catch in 1994 of 266 000 t. The range of the two species within this catch group, *M. capensis* and *M. paradoxus*, extends over South Africa and Namibia, with the shallow water Cape hake, *M. capensis* also extending into Angola. Catches in Namibia and on the Agulhas Bank on the southern tip of Africa, are dominated by *M. capensis*, while along the West Coast of South Africa *M. paradoxus* is the dominant component of catches. The large eye *Dentex* is an important demersal species in Angola and supported landings of over 2 000 t in 1993 and 1994. The landings of hakes in the region reflect the very heavy exploitation of the 1960s and 1970s (Figure B7.4).

The primary crustacean stocks in the region are the red crab *Geryon maritae* (included in Geryons nei), shrimps and the Cape rock lobster. The red crab is caught mainly by foreign vessels and landings totalled over 5 000 t in 1994, while shrimps, mainly caught in Angola, accounted for landings of over 6 000 t . The Cape rock lobster has declined greatly since the early 1950s (Figure B7.5). The major fishery on molluscs was, for most of the last

five decades, the South African fishery for perlemoen abalone. Catches of this species peaked at over 4 000 t in the mid-1960s but have been reduced drastically over time, and recorded landings have been maintained at approximately 600 t since the mid 1980s (Figure B7.6).

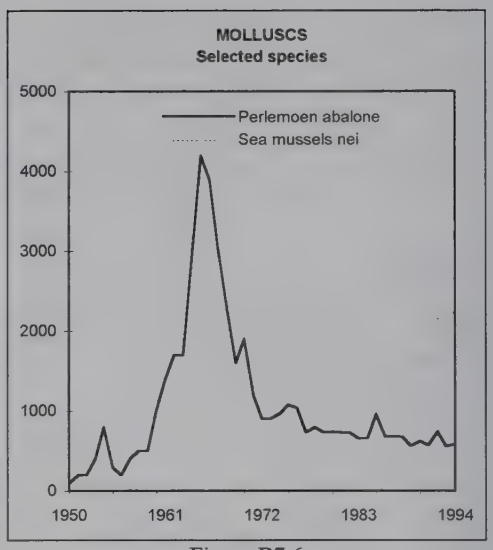


Figure B7.6

RESOURCE STATUS AND MANAGEMENT

The pelagic fisheries are particularly important in Namibia and South Africa within region 47, and the stocks are closely monitored in both countries, making extensive use of hydroacoustic surveys. In November 1994, hydroacoustic survey results suggested that sardine (597 000 t) was more abundant than anchovy (476 000 t) in South African waters for the first time since such surveys were started there in 1984. This reversal persisted in November 1995, but the estimated sardine biomass had decreased marginally to 580 000 t over the year. However, during this period the northern component of the sardine population, occurring in Namibia and Angola, has been estimated to have declined from approximately 800 000 t in 1992 to less than 100 000 t at the end of 1995. At the same time, it has contracted towards the warm frontal zone in Angola. As a result of this shift, Namibian vessels were licensed to fish in Angolan waters for the first time in 1995. The decline in sardine abundance in the northern Benguela has also been associated with the unusually anoxic state of the coastal marine environment.

A secondary result of the shift of the northern sardine stocks into Angola, described above, was a similar shift northwards of the Cape fur seal, causing concern in Angola of adverse impacts on the local fish resources through increased predation. This movement of seal northwards followed reported incidences of starvation-induced mortality of seal pups in 1994, followed by high incidences of abortion of foetuses and of adult mortality. Clearly, the Benguela system in the region of Namibia and southern Angola has been suffering a severe environmental anomaly.

Both stocks of Cape hakes were heavily depleted in the 1960s and 1970s (as reflected in the catches described above), before more conservative management approaches were instituted. Since then the stocks are estimated to have recovered somewhat and, in Namibia, to have recovered particularly after independence, when foreign fleets were prevented from fishing in the country and conservative TACs were introduced. Within South African waters, there have been no major anomalies in the population trends detected in recent years and the hake stocks are generally considered to be either stable or to have increased to some extent since the over-exploitation of two decades ago. However, Namibian surveys in their own waters have suggested substantial declines in the abundance of *M. capensis* hake stocks since 1993, possibly as a result of unusually low oxygen levels along the coast. The total allowable catches for the species group have been set at 150 000 t 1996 in both South Africa and Namibia.

The status of the Cape rock lobster stock is cause for concern, and catches for the sub-region have declined virtually continually since the 1950s (described above), despite conservative management approaches in both Namibia and South Africa, where catches are taken. There was some apparent growth of the biomass in South Africa in the mid 1980s, possibly in response to a reduction in the TAC from 5 600 t in the 1970s to 3 600 t in 1981. However, the population was struck by very low somatic growth rates in the late 1980s and, despite reductions in the TAC to a low of 1 500 t in 1995/96, the population appears to have continued to decline. The catches in Namibia and South Africa in 1994 were 134 t and 2198 t respectively. The other major contributor to the landings of Group 43 is the Southern spiny lobster. Landings of this species had been maintained at approximately 1 000 t since 1990 but have been reduced slightly since 1994 as a result of new estimates of the productivity of the stock.

Since the peak landings of abalone in the 1960s, more conservative management approaches have been implemented and, under TAC control, the recorded landings have been relatively constant at approximately 600 t in recent years. There is some concern over the status of the stock, however, particularly in the light of unknown but suspected high, levels of illegal catch. Mariculture has had a pronounced impact on the production of molluscs from the region, and culture of the Mediterranean mussel, started in 1985, has risen to 2 300 t, with another 400 t of unidentified mussels in 1994. Between approximately 500 and 600 t per year of Pacific cupped oyster has also been produced by mariculture since approaching a plateau in 1989.

A growing fisheries management issue in the area is the rapidly increasing interest in fisheries for deepwater species including orange roughy *Hoplostethus atlanticus* and Patagonian toothfish *Dissostichus eleginoides*. The former has been found within the continental EEZs of the three countries and is suspected to be a straddling stock, extending outside the EEZs as well. The Patagonian toothfish occurs within South Africa's EEZ around Prince Edward Island in the Southern Ocean and also extends into international waters. The countries of the region are currently discussing the establishment of one or more multilateral organizations to oversee management of these multilateral stocks. There is a strong desire to avoid a rapid depletion of the slow-growing stocks and to manage them in a responsible and sustainable manner.

8. WESTERN INDIAN OCEAN

FAO Statistical Area 51

INTRODUCTION

Figure B8.1

The Western Indian Ocean area (Figure B8.1) has a surface area of ~30 million km^2 and encompasses regions with greatly differing fishery resources characteristics. The Northwest Arabian Sea contains areas of nearly continuous upwelling (off the Oman coast) and thus extremely high productivity as well as areas with seasonal upwelling also resulting in periods of high productivity as off the coast of Iran and Pakistan in the Gulf of Oman and Arabian Sea. This monsoon-induced upwelling extends to the west coast of India. The Persian Gulf, a shallow enclosed area characterized by warm saline waters has fisheries characteristic only to that area while in the Red Sea, narrow continental shelves and an enclosed nature also create unique fisheries situations. The Gulf of Aden and Somali coast are also monsoon-driven upwelling areas that experience seasons of high productivity. Area 51 also contains some small oceanic islands, The Seychelles, Mauritius and the Comoros, that have their own characteristic fisheries reflecting their oceanic or near-oceanic character. Further to the south, South Africa has fisheries of a temperate and sub-Antarctic nature.

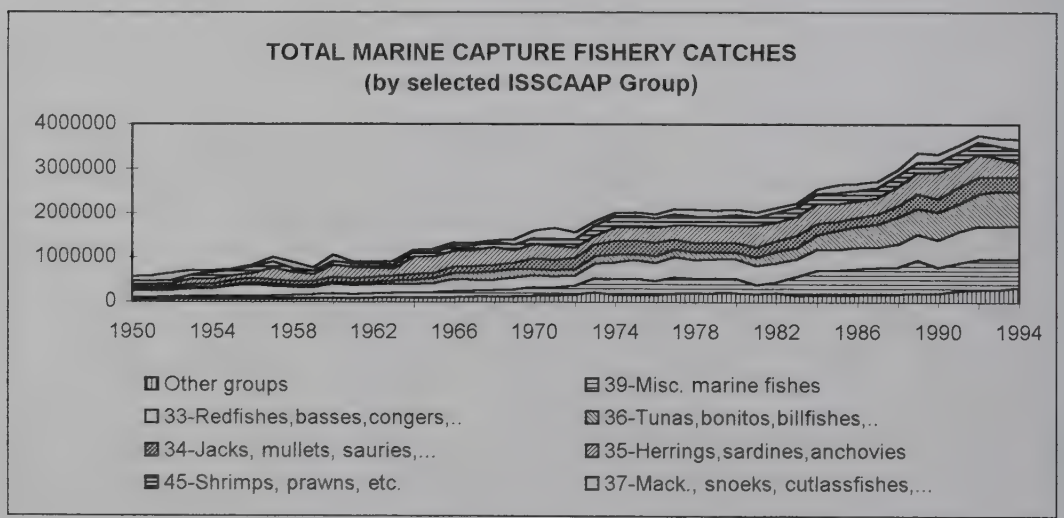


Figure B8.2

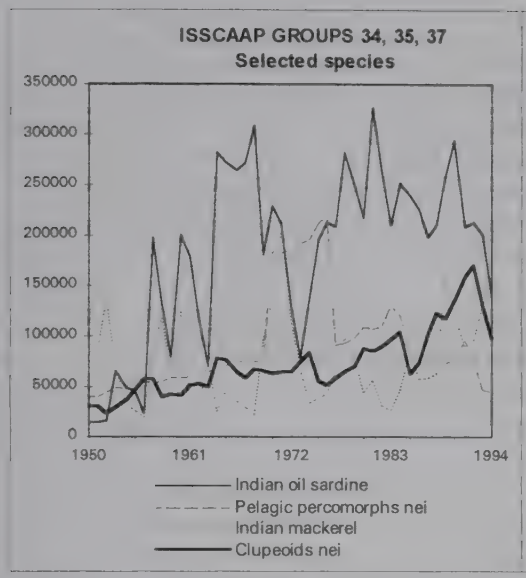


Figure B8.3

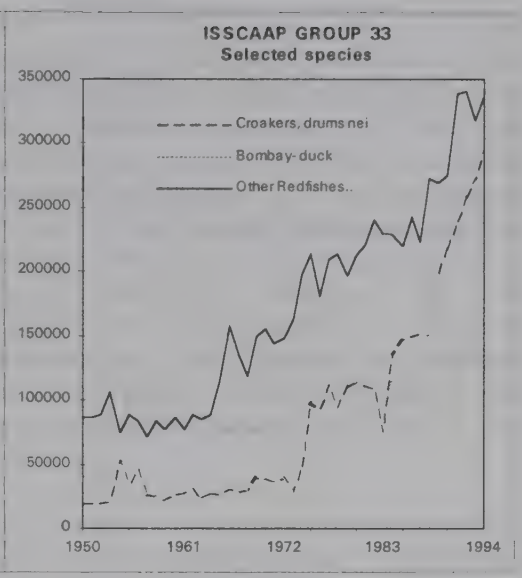


Figure B8.4

Of major interest in this area is the start of a long anticipated meal fishery for myctophids (*Benthosema pterotum*) in the Gulf of Oman and Arabian Sea (see Special Topic section: "*Lanternfish: A Potential Fishery in the Northern Arabian Sea?*"). The development of this fishery raises a number of yet to be answered questions, such as the importance of this resource to other components of the ecosystem, especially the large migratory scombrids, and the existence of the stock or population structure of this species in its potential fishery area. With the advent of peace in Eritrea, exploitation of the marine resources of that country is becoming regulated, and a start is being made at developing formal management procedures. This process has still to start in the waters of Somalia, though fishing effort is reported to be high due to both 'approved fishing activities' and those of completely independent operators.

PROFILE OF CATCHES

Total marine capture fishery catches in the Western Indian Ocean increased from a 1950's catch of ~0.5 million tonnes to nearly 3.8 million tonnes in 1992, since when they have declined slightly (Figure B8.2 and Table VIII). This recent small decline in total catches is largely the result of a drop in the landings of the small pelagics of ISSCAAP Group 35 (herrings, sardines, anchovies, etc.), of which Indian oil sardine is the major identified species (Figure B8.3). Catches of Indian oil sardine have varied widely over the last four decades, as have catches of several of the other major pelagic resources of ISSCAAP Groups 34 (jacks, etc.) 35 (herrings, etc.) and 37 (mackerels, etc.).

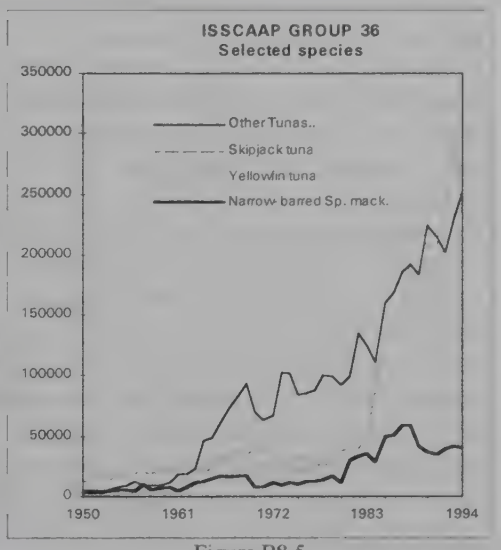


Figure B8.5

These resources include Indian mackerel and various clupeoids and pelagic percomorphs (Figure B8.3). The recent decline in pelagic percomorphs is largely due to declines in the Persian Gulf and Gulf of Oman, where the species form the basis of the most important commercial fishery in the area. In contrast, the catches of demersal species, almost entirely from ISSCAAP Group 33 (redfishes, etc.) have increased relatively steadily since 1950, with particularly large increases since the early 1980s coming from various species of croakers and drums (Figure B8.4).

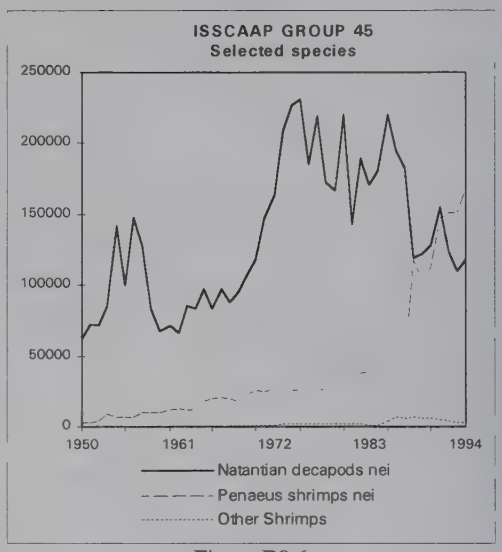


Figure B8.6

Catches of the large pelagics of ISSCAAP Group 36 have also increased relatively steadily since the 1950s, with large increases in skipjack and yellowfin being reported since the early 1980s (Figure B8.5). While total catches of the crustaceans of ISSCAAP Group 45 (Shrimps, prawns, etc.) appear to have been relatively constant since the early 1970s (Figure B8.6), catches of valuable penaeid shrimps have increased sharply since the mid 1980s. Catches of various of these species are of tremendous local importance in certain parts of the region.

RESOURCE STATUS AND MANAGEMENT

Eastern Arabian Sea: Pakistan, India and Sri Lanka

The enormous number of small fishing vessels in this area makes monitoring of stock status and implementation of fisheries management measures difficult. Almost any form and size of fish that can be caught is saleable. Given the scarcity of alternative employment, fishing intensity will remain high, increasing whenever the catch rates and economic conditions will allow it to do so. Small-scale shrimp fisheries are important in both Pakistan and along the west coast of India. Gear restrictions are few and the size and range of fishing effort creates major difficulties for management.

The Persian Gulf and Gulf of Oman

Fisheries have been important in this area since ancient times, both for subsistence purposes and trade. The pearl fishery of the Persian Gulf has been famous in the past, though it is now continued at a fraction of the level of former times. Rising incomes and the traditional popularity of fish as a dietary item have resulted in virtually all resources of the area becoming fully exploited, one exception being the Indian round herring, mainly because of lack of consumer preference. The fisheries of today are carried out by motorized dhows and sambuks, smaller wooden vessels and industrial-style trawlers. These are found in most countries of the region, the exceptions being the United Arab Emirates, where trawling has been banned, and Iran, which has severely limited the ability to use trawlers inside the Gulf to a shrimping season.

The Persian Gulf itself is characterized by high-temperature highly saline water, which enters from the Gulf of Oman forming an counter-clockwise gyre then exiting as a submerged, denser warmer and saline water mass moving towards the centre of the Indian Ocean. The Persian Gulf is shallow, deeper on the Iranian side and fringed with extensive coral areas on the Arabian side. Around the Gulf of Oman the continental shelf is extremely narrow, and fisheries concentrate on pelagic species, which in the last decades has increasingly meant the medium-sized pelagics such as *Scomberomorus* spp. and various species of tunas.

Past conflicts in the area (the Iran-Iraq war and the invasion of Kuwait) have had severe impacts on recent fisheries, not least because of disruption of fishing activity but also because of environmental effects arising from oil pollution, or at the time of the invasion of Kuwait, from the shadowing and pollution caused by burning crude oil wells.

Three key resources of concern in the area are those of Spanish mackerel, shrimp (various *Penaeid* and *Metapenaeid* species) and the various percid fishes. Useful information on the fishes is difficult to glean because of the quality of statistics in some countries and the practice of reporting data in a highly aggregated manner. The available catches data suggests that most groups of fish species are fully exploited. The trend in catches of the perciform group is probably the best indicator for stock status in the region, because the majority of species in the perciform group are commercially fished. The catches in the perciform group dropped for two years in a row (10.2% between 1993 and 1994) and are now some 53 000 t below the levels of 1992. Catches of invertebrates are still below the 1987-88 peak (the decline largely coming from a drop in shrimp catches by Oman) but have been increasing since 1991. This recent increase may be the sign of recovery.

The Red Sea and Gulf of Aden

The Red Sea and to a lesser extent, the Gulf of Aden, being ancient sea ways have also been, at least regionally, important for their fisheries. However, the oligotrophic nature of the Red Sea, a body of water surrounded by countries with narrow continental shelves and coral outcroppings, means that fisheries, while significant locally, are not important in global terms. Several coastal states have had regionally important shrimp fisheries, particularly Saudi Arabia and the Yemen and, to a lesser extent, Eritrea. As with similar tropical areas, the fisheries resources can be characterized as those associated with coral reefs, small pelagics fisheries and those for the larger more mobile scrombroids, including some tunas. Where possible, trawl fisheries are carried on, generally using trawls with extremely small mesh in their codends, taking a wide variety of perciform fishes. With the exception of some small pelagic resources, the status of the different resources may be assumed to be fully exploited.

In the Gulf of Aden, large industrial fisheries using 'distant water' factory trawlers based in the area have exploited demersal and small pelagic fish resources in the past, but because of lack of profitability have not been functioning for some time. The situation in Somalia remains confused with informal reports of many small fishing companies starting operations and also high levels of illegal fishing, particularly outside of the Gulf of Aden.

With the coming of independence to Eritrea, this country has been renewing efforts to develop its marine fisheries. Licencing agreements had been reached with Egypt for trawling operations by that country's vessels. Fishermen also continue to land catch into Yemen which could result in misrepresentation in the reported landings for both countries.

No explicit recent stock assessment based information is available for this area, and the use of catches data as an indicator of state of exploitation is compromised because the FAO fisheries data base aggregates data from Saudi Arabia for both the Red Sea and Persian Gulf. However, the available data show clearly that the rate of increase in catches by regional countries has declined sharply during the 1990s and that catches have been effectively constant over the last few years. No species or species group has shown significant increases in catches, while catches of certain species are now well below the peak levels seen in earlier years (although, in some cases, this might be due to changes in market conditions as noted below). More detailed analysis of the data is unjustifiable because of the high level of 'estimated' landings for these countries and changing patterns in disaggregation of the data. Increases in different categories appear to be best explained by increased disaggregation by species in the reported figures.

The small areas available for trawling and absence of any effective regulation in many areas of the Red Sea probably result in fisheries that are quickly fully exploited or overexploited. Markets for fish in the area are strong, particularly in the Yemen and Egypt and for higher-priced species in Saudi Arabia. Low market demand for small pelagics has resulted in reduced fishing for these species, particularly with the withdrawal of East European operators who supplied home markets. This fishery appears to have ceased at the beginning of the 1980s.

Coastal East Africa (Somalia to Mozambique)

The East coast of Africa represents a wide range of oceanographic environments and the western Indian Ocean is the site of some of the most dynamically varying large marine ecosystems in the world. The Somali Current develops during the southwest monsoon to become the fastest open-ocean current in the world. The coastal upwelling that occurs along the African coast during the intensified phase of the Somali Current is the most intense large-scale seasonal coastal upwelling system in the world. Other nearby regions are also strongly influenced by the annually reversing monsoon regime. However, the region is also uniquely puzzling because the coastal fish production seems minuscule for such a large area. The coastal fishery yield along the entire western boundary of the Indian Ocean, including the various island states of the western half of that ocean, represents less than one percent of the global landings. In spite of this, most of the coastal fish stocks of the region are considered to be fully exploited or overexploited.

Coastal fisheries production usually far outweighs production from oceanic species such as tunas and generally constitutes around 90-95% of total landings, but in the southwestern Indian Ocean the contributions of coastal and oceanic fisheries are approximately equal. The Indian Ocean continental shelf of Africa is relatively narrow, and this might provide some explanation for the low coastal landings. However, the disparity in continental shelf area compared to other ocean regions is far less drastic than would be necessary to adequately explain the above anomaly in fish production.

While the coastal fisheries are harvested mostly by coastal states, the more lucrative oceanic fisheries are harvested mostly by distant-water fishing fleets from Europe and eastern Asia. Even so, and despite the low coastal landings, fishing and its associated economic activities are often extremely important to local economies. In some of the southwestern Indian Ocean countries, fish are nearly the sole source of animal protein available to the local populations. Moreover, in a region faced with chronic scarcities of foreign exchange, exports of fishery

products represent vital sources of exchangeable earnings. The shrimp fishery on the Sofala Bank contributes up to 40% of Mozambique's foreign exchange, despite seemingly low landings (<10,000 t).

While total landings in 1995 were relatively high, (7 344 t), the largest since 1986, yield per recruit analysis indicates that nearly the same level of catch could be taken with about 30% less fishing effort. In addition to cost-related improvements in economic efficiency and performance, the higher shrimp biomass associated with lower effort levels reduces the risk of recruitment failure (and may result in increased recruitment) and results in greater average size of landed shrimp. Since larger shrimp fetch a higher price per unit weight than smaller individuals, the increases in total revenue will be greater than the increases in quantity landed. Shrimp catches are also one of the most important components of landings in Madagascar because of their importance to foreign exchange earnings. Landings in 1995 were marked by a reduction of 16% to 7 623 t, of which a small increase had been registered in the artisanal catch, from 188 t to 283 t. The average catch rate was 576 kg/day. Landed bycatch represented 45% of landings; a total of 3 445 t of fish were landed by the shrimp trawlers. This was a 27% increase over 1994.

Landings by regional countries in the area have stagnated somewhat since the 1990s. Many of the reported catches are not identified to species (42% in 1994), preventing an analysis of resource status at species level. However, there does not appear to have been any reductions in fishing effort and thus the relative constancy of catches indicates that the resources exploited by regional countries may be "fully" exploited. However, reported catches by distant-water fishing nations have increased dramatically through the 1990s (from ~325 000 t in 1990 to ~430 000 t in 1993 and ~400 000 t in 1994), with Spain and France together accounting for over 50% of these catches.

9. EASTERN INDIAN OCEAN

FAO Statistical Area 57

INTRODUCTION

The Eastern Indian Ocean (Figure B9.1) includes the Bay of Bengal in the north, the Andaman Sea and northern part of the Malacca Straits in the east, and the waters around the west and south of Australia. The main shelf areas include those of the Bays of Bengal and Martaban and the narrower shelf areas on the western and southern sides of Indonesia and Australia. Most of the coastal fisheries are concentrated in these shelf areas and are the main fisheries in the region. The resources range from typical tropical species found in the northern part of the area to temperate species in the waters of the southern latitudes west and south of Australia.

Figure B9.1

The fisheries of the Eastern Indian Ocean are characterized by increased fishing pressure, especially in inshore areas. The coastal areas off the east of India, the west of Thailand and the south coast of central Java are good examples of areas where fishing pressure has kept increasing. Knowledge of the fish stocks is generally poor and management actions taken have usually been on an *ad hoc* basis, in most cases with lack of scientific backup.

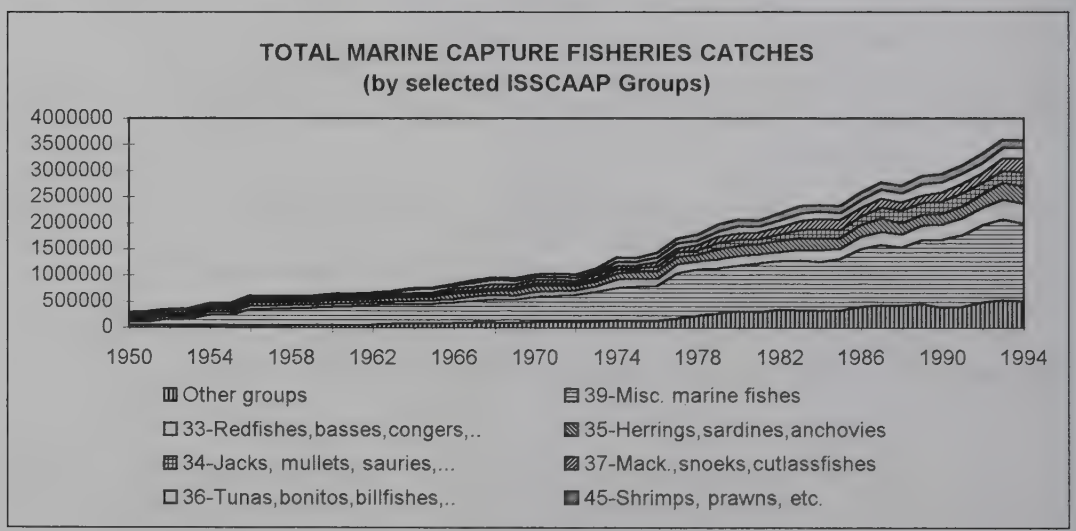


Figure B9.2

PROFILE OF CATCHES

Catches in this region have increased since 1950. In the mid 1970s the rate of increase nearly doubled and has remained at a higher level since, although catches in 1993 to 1994 were stabilized. Catches of five countries (India, Indonesia, Malaysia, Myanmar and Thailand) accounted for 90% of the total in 1994. The absence of Bangladesh as a major marine fishing nation, despite a large population, is due to the historical focus on the large freshwater fishery resources. The catches of Australia made up only 3% of total catches by weight but contributed a much higher proportion in terms of their economic value.

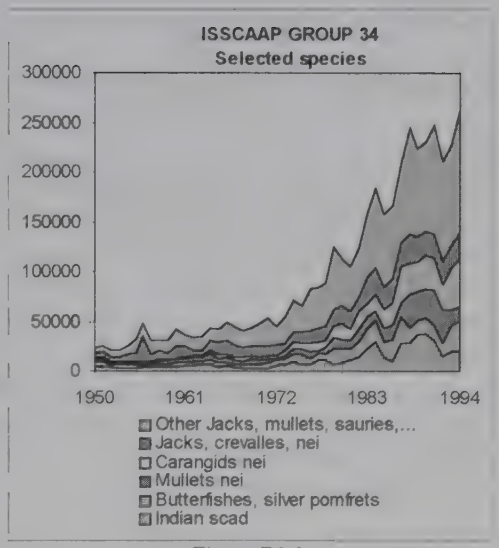


Figure B9.3

Seven major ISSCAAP Groups account for 84% of the total catches: miscellaneous marine fishes (39); redfishes (33); herrings (35); jacks (34); mackerels (37); tunas (36) and shrimps (45) (Figure B9.2 and Table IX). The catch reported as miscellaneous fishes (principally made up of small fishes and juveniles of some high-valued fishes) accounted for 39% of the total catches in 1994. Although the continued increase of catch of this group may indicate the augmented fishing pressure, the relatively high figure has been also caused by the incomplete or poor statistical collection of some member countries, on which assistance is needed.

Other than miscellaneous fishes, the contribution of the other main ISSCAAP Groups is approximately equal, and no single identified group dominates the total catches. Catches at a species level within ISSCAAP Groups are also generally distributed relatively equally among a large number of species, none of which can be identified as the key factor in explaining the pattern of total catches within each group (for example, Figure B9.3 shows the catches by main species within ISSCAAP Group 34). However, in certain ISSCAAP Groups single species or species groups stand out (i.e. the catches of Indian mackerels shown in Figure B9.4).

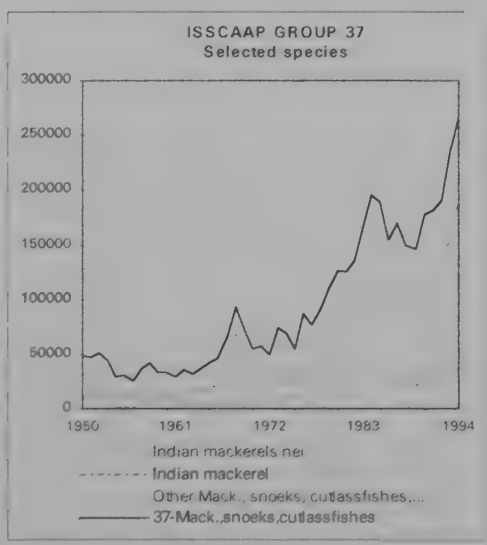


Figure B9.4

The rate of increase of catches by ISSCAAP Groups generally shows the same trend as that of total catches, with a slow increase from 1950 to 1970, followed by a more rapid increase in the last 20 or so years. However, the rate of increase in catches of shrimp has slowed since the early 1980s while catches of shads have apparently climbed sharply since the early 1980s (Figure B9.5). The slowing rate of increases of shrimp catches is thought to be due to local overexploitation of the

resource (see below). Shads are traditionally the main catches of marine fisheries in Bangladesh. The sudden increase in catches in the mid-1980s is an artifact caused by the fact that Bangladeshi statistics on shad catches started in 1984.

RESOURCE STATUS AND MANAGEMENT

Northern areas

Most of the catch from coastal fisheries is used for local consumption. Fish are generally considered an affordable source of protein by most people in the region. Shrimp and tuna are the main export commodities. Overexploitation of shrimp resources in coastal waters have reduced the amount of exports from capture fisheries, and there is a growing tendency for exports to come from the aquaculture sector in almost all countries in the region. While the majority of tuna catches are from coastal fisheries, the skipjack and yellowfin tuna, which form the major part of the tuna exports, are caught offshore. During the last decade some countries have developed offshore fishing for tuna, notably longlining in the case of Indonesia and purse seining in the case of Thailand.

Though squid is commercially important, its production is small, with only Thailand producing relatively high catches (40 000 t in 1994 compared to only 15 000 t in 1984). Thailand contributed more than 50% of the total catch. Some of the Thai fleets have also expanded to fish in other countries through various joint agreements. It is likely that potential for development of this fisheries exists in the region, although further work is still needed in assessing the resources, in addition to the familiarity with the fishing technique.

Overexploitation of the resources in coastal waters is very much related to the population pressure in the coastal area. With the limited access of waste treatment in most countries in the region, organic material and nutrification seems to be the major problem in aquatic pollution. The cyclones that enter the Bay of Bengal are a considerable natural hazard to fishers, particularly given the absence of good weather forecasts and the poor level of electronic equipment on most fishing vessels. There is a resulting high casualty among fishermen during the cyclone season.

Southern areas

The main fisheries in the southern part of the Eastern Indian Ocean are the fisheries off the west and southwest of Australia. The lobster fishery is one of the important fisheries in this area. The fisheries have been relatively steady since 1980s and the catch in 1994 amounted to 16 000 t. On the other hand, tuna catches that had climbed up and reached the peak of 19 700 t in 1985, have declined since, and the catch in 1994 amounted to 5 900 t. In response to the decline, Australia has promoted the management of the southern bluefin tuna where Japan and New Zealand have also participated. The trend in catches of the herrings group (ISSCAAP Group 35) showed a similar pattern as the tuna

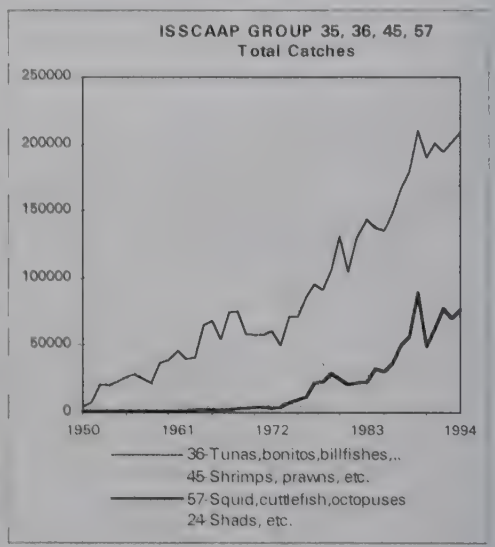


Figure B9.5

catch, with the peak in 1989 of 17 000 t after which the catch declined and in 1994 the catch was about 11 000 t. It is not clear whether the decline is attributable to either the increase of fishing pressure or environmental changes or both.

The trend of catches of miscellaneous fishes (ISSCAAP Group 39) shows an interesting feature. The peak catches of about 28 000 t occurred in 1975 and 1993 but in between the catch was as low as 1 000 t (in 1985). A similar pattern is seen in the catch of scallops (ISSCAAP Group 55), which showed peaks in 1984 and 1993 of about 27 000 t but in 1989 catches were down to 1 000 t. No clear explanation could be found for this pattern of catches of these two resource groups.

10. NORTHWEST PACIFIC

FAO Statistical Area 61

INTRODUCTION

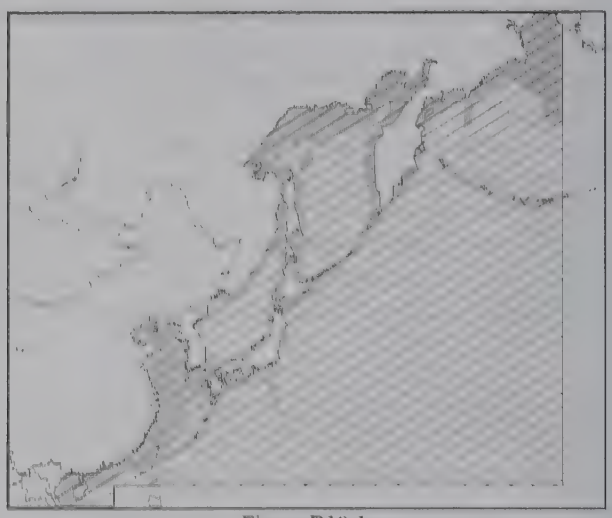


Figure B10.1

This Area (Figure B10.1) encompasses a number of distinct regional ocean subareas, many containing particular extensive areas of highly productive continental shelf (i.e. the northern portion of the South China Sea, the East China Sea, the Yellow Sea, the Sea of Japan and the Sea of Okhotsk). Other subareas have less extensive continental shelf areas but are nevertheless also sites of productive fishery resources (e.g. the western portion of the Bering Sea, the eastern edges of the Ryukyu Islands, Japan, and the Kuril Islands, and the southeastern part of the Kamchatka Peninsula), being characterized by zones of enrichment and concentration of biological processes related to interactions and confluences of swift western ocean boundary currents.

Catches of Alaskan pollock declined by 2.3 million tonnes since 1988 and catches of the Japanese pilchard (sardine) dropped by a massive 4.1 million tonnes; declines of 45% and 76% respectively. The decline of the pollock is thought to be related to excessive fishing pressure, although the evidence suggests at least some environmental component (see Special Topics section: "*Global synchrony in fish population variations*"). However, it is believed that the sardine collapse must have been primarily due to some sort of natural ecosystem variability.

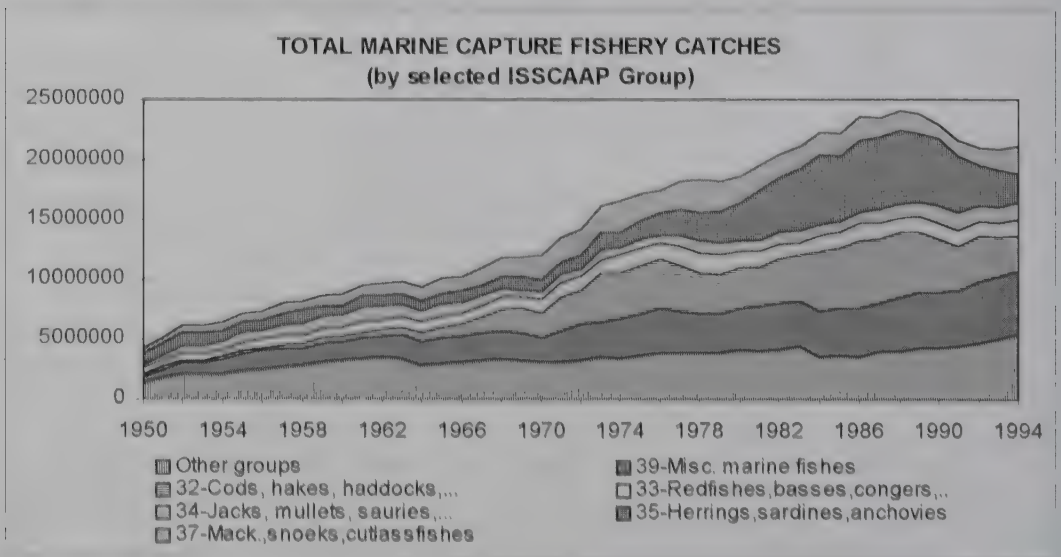


Figure B10.2

PROFILE OF CATCHES

Total catches in the Northwest Pacific increased steadily throughout the 1950s and 1960s as catches of a wide range of species increased (Figure B10.2). The continued increase through the 1970s and 1980s was primarily due to the expansion in catches of just two species: Alaskan pollock and Japanese pilchard (or sardine). Total reported capture fishery landings for 1994 in Area 61 totalled 12 million tonnes, a decline of 4.7 million tonnes or nearly 28 percent from the historical peak landings of 1988. Most of the decline came from the two populations with the largest potential biomass: the Alaska pollock and the Japanese pilchard (Figure B10.3). Because these populations had been so enormous, their collapses have been only minimally offset by strong rises in landings of many other species, including increases of about 517 000 t (+170%) of Japanese anchovy, 499 000 t (+94%) of largehead hairtail, 288 000 t (+140%) of Japanese flying squid and 130 000 t (+51%) of salmon.

The strong rise in Japanese anchovy catches that began in 1990 comes after decades of relatively constant catches at around 350 000 t (Figure B10.4). 1994 landings of both chub mackerel and Japanese jack mackerel were the highest in a number of years but were still well below levels of two to three decades ago. The chub mackerel fishery has, on average, been around four times larger than that for Japanese jack mackerel. Chub mackerel landings were about 26% below the averages for the decade of the 1970s while jack mackerel landings were about 20% below the norm for the decade of the 1960s (Table X).

Pacific herring catches declined rapidly in the early 1970s, rebounded somewhat in the mid 1980s, and then declined again, with the 1994 catches being only about one-fourth of the average for the decades of the 1960s and 1970s (Figure B10.4). The recent increase in largehead hairtail catches began in 1990 and peaked in 1994, with slightly over 1.0 million tonnes landed. Pacific cod catches have followed the general pattern of the pollock and other North Pacific groundfish in declining from levels existing in the 1980s (down by 28% from 1988).

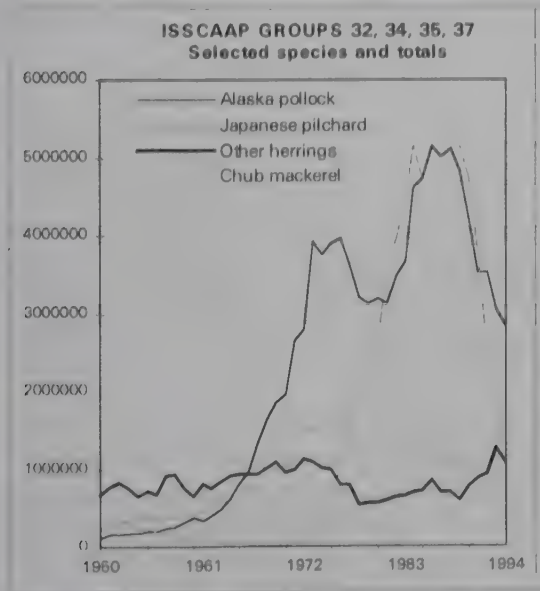


Figure B10.3

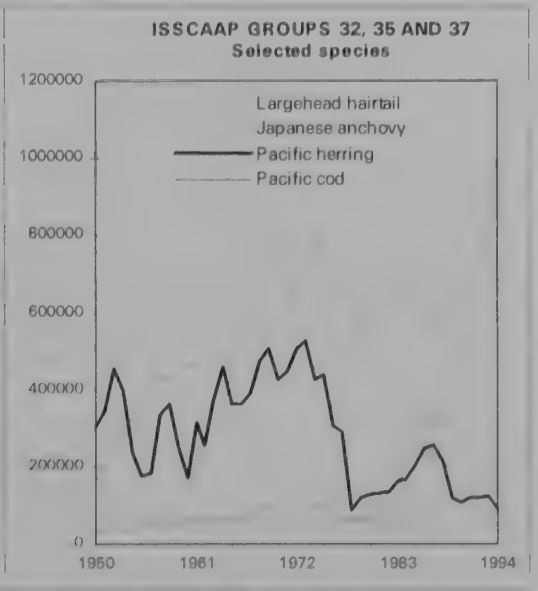


Figure B10.4

The major salmon species in the northwestern Pacific are the chum salmon, which ordinarily produces the largest catches, and the pink salmon. The chum salmon landings in 1994 were at an all time high. The pink salmon landings were up from the previous two years, being about at the level which was the norm for the 1950s, but substantially down (a 44 percent decrease) from the all-time peak catches of 1991 (Figure B10.5).

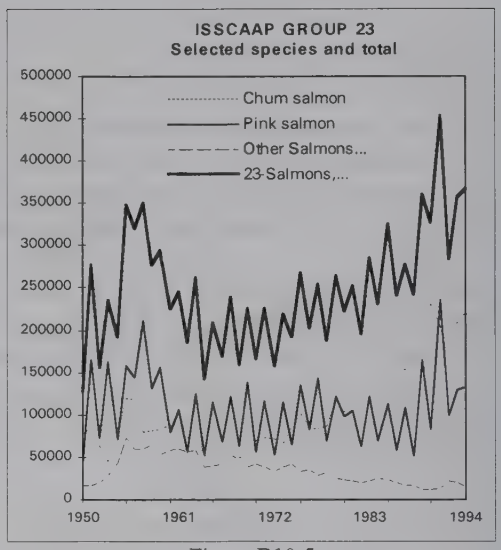


Figure B10.5

Catches of various crustacean species have increased greatly since the mid-1970s (Figure B10.6). No single species dominated the catch totals at the ISSCAAP Group level, although the catches of Akiami paste shrimp (of Group 45) and Gazami crabs (of Group 42) have made significant contributions.

Catches of Japanese flying squid (*Todarodes pacificus*, also called Japanese common squid) have increased in recent years after declining from high levels in the mid 1960s. In 1994 the total amount of squids, cuttlefish and octopuses landed in Area 61 reached an all time high of about 958 000 t (Figure B10.7).

RESOURCE STATUS AND MANAGEMENT

Small pelagics

As mentioned above, the largest marine resource variations in the region have concerned the Japanese pilchard (or sardine) population. The sardine fishery off Japan grew rapidly in the 1930s to become the largest single-species fishery existing in the world at that time. Then in the early

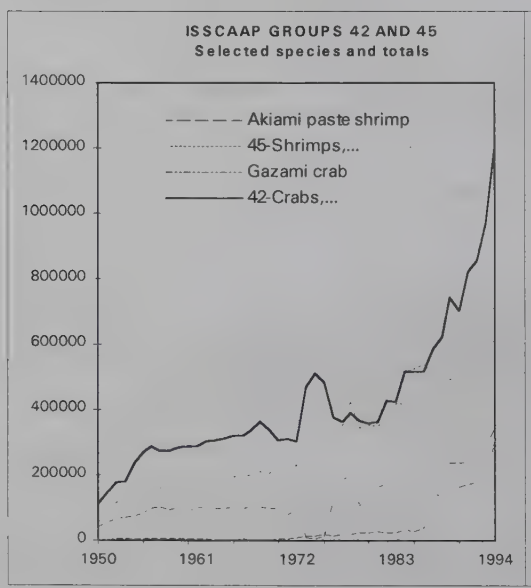


Figure B10.6

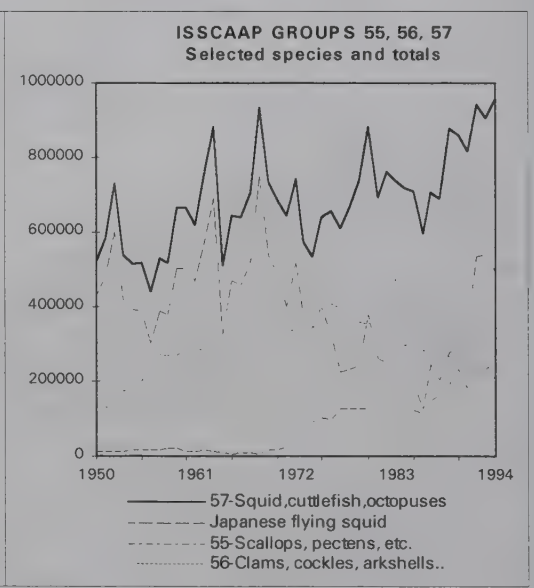


Figure B10.7

1940s the population abruptly collapsed. It remained at extremely depressed levels for nearly three decades and then suddenly exploded in the mid-1970s into a rapid rebuilding phase that led in the 1980s to catches more than twice as large as attained in the peak catches before the earlier collapse (see also in Special Topics section: "*Global synchrony in fish population variations*"). Now the population, after sustaining major fishery exploitation for a length of time quite similar to that of the earlier fishery, has gone into rapid decline a second time. By 1994 fewer than 1.3 million tonnes were landed (mostly by Japan, but with some catches by China and Republic of Korea) and up to the present time, 1996, the population is continuing to decline and the stock is now at a very low level. Japanese scientists are convinced that the fluctuations in sardine abundance are not the result of fishing but rather are governed by ecosystems changes which may be related to climate variation.

After heavy fishery removals of demersals and larger predatory fishes, Japanese anchovy has taken over as the largest catch in the Yellow Sea, while off Japan anchovy stocks appear to be fluctuating at intermediate levels. Of the 1994 total landings of 821 000 t, 439 000 t were by China, 193 000 t by Republic of Korea, and 188 000 t by Japan. The all-time peak catches were in 1993, when a total of 1.0 million tonnes of Japanese anchovy were landed.

Chub mackerel stocks are considered to be at a low level and there is no sign of recovery; the largest catches are by Japan, but Republic of Korea and China land substantial quantities. On the other hand, the jack mackerel stocks appear to be increasing and are considered to be at an "intermediate level"; the largest catches are by Japan with a minor amount being taken by the Democratic P.R. of Korea. Pacific saury landings have continued to vary quite consistently in a range between about 300 000 and 400 000 t for the past four decades, but the stocks appear to be starting to decline.

Groundfish resources

Currently, the largest fish catches in this Area continue to be of Alaskan pollock, with by far the largest portion being taken by the Russian fishery which landed 1.75 million tonnes in 1994. Other important fisheries on pollock are by Republic of Korea (297 000 t) and China (130 000 t). The overexploited state of this fishery is becoming more and more apparent, and a continuing trend is reported toward an increasing proportion of low value, undifferentiated fish in the landings.

The largest pollock stocks in the northwest Pacific are believed to be those in the Sea of Okhotsk, but the largest recent catches have been in the western Bering Sea where there are reports of large bycatch and discard of small pre-recruit pollock. Other stocks are located off eastern Kamchatka, near the Kuril Islands, off western Japan, and a heavily fished stock in the Japan Sea. All the major stocks are believed to be currently at substantially lower biomass levels than existed in the 1980s and there are forecasts of catch trends continuing downwards for several years into the future. The unregulated fisheries that produced very high catches in the late 1980s and early 1990s in the international waters of the "Doughnut Hole" and "Peanut Hole" have been curtailed.

Pacific cod biomass appears to have increased in the western Bering Sea, but it is unknown whether this is due to local recruitment or its movement from the extensive shelf areas of the stock is increasing (also see discussion of Area 67). Also, it is possible that abundance may be higher in the Sea of Okhotsk than indicated by catches, because of trawling closures designed to protect king crab.

Other Resources

In recent years, the stocks of Japanese flying squid are believed to be fluctuating at intermediate to high levels.

General Concerns

Fishing effort in the region has continued to rise. For example, in the East China Sea the total fishing power of Chinese vessels increased by a factor of about 7.6 between the 1960s and 1990s; catch-per-unit-effort declined over the same period by a factor of 3. In coastal seas such as the East China and Yellow Seas, there has been a shift in catches from large high-valued fish to lower-valued smaller fishes, from demersal and pelagic predator fishes to pelagic plankton-feeding fishes, from mature fish to immature fish. Reduction of fishing effort in some areas is considered an urgent priority.

Environmental problems affecting fisheries in the region include land reclamation, impacts of extensive mariculture, heavy metal pollution and oil spills. There appears to be an increasing frequency of red tides. In the Yellow Sea, virus and bacterial epidemics are causing mortality of cultured shrimp.

11. NORTHEAST PACIFIC

FAO Statistical Area 67

INTRODUCTION

The Northeast Pacific (Figure B11.1) encompasses several distinct regional ocean subareas (i.e. "Large Marine Ecosystems"), including the northern portion of the California Current region, the Gulf of Alaska and the eastern part of the Bering Sea. These subareas embody distinctly different environmental dynamics. The California Current is a classical subtropical eastern ocean upwelling system. The subarctic systems of the Gulf of Alaska and Bering Sea are dominated by the Aleutian Low pressure cell, one of the most intensive, quasi-permanent atmospheric systems on earth. In the Gulf of Alaska, the result is intense coastal convergence which drives anti-clockwise coastal flow around the periphery of the Gulf which interact with coastal runoff to produce embedded frontal zones of concentration of biological processes. The eastern Bering Sea is a shallow shelf system, characterized by tidal mixing and related shelf-sea formations.

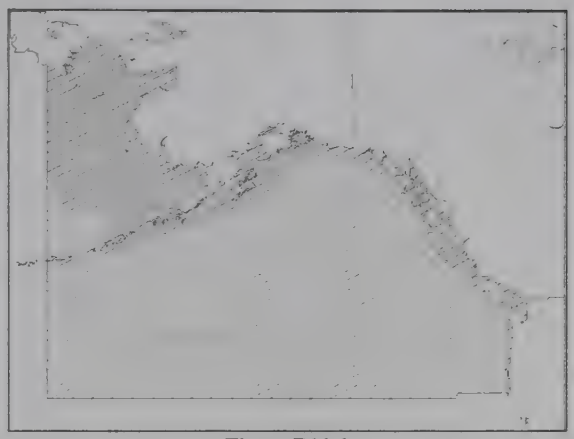


Figure B11.1

PROFILE OF CATCHES

Total reported capture fishery landings for 1994 in this Area totalled 3.0 million tonnes, a decline of ~184 000 t or nearly 6% from the historical peak landings of 1993 (Figure B11.2 and Table XI).

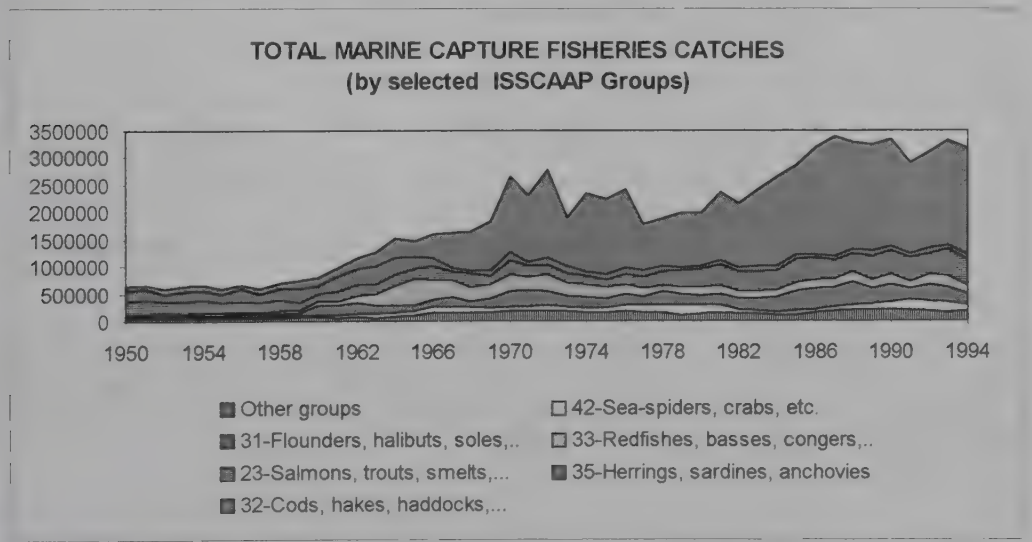


Figure B11.2

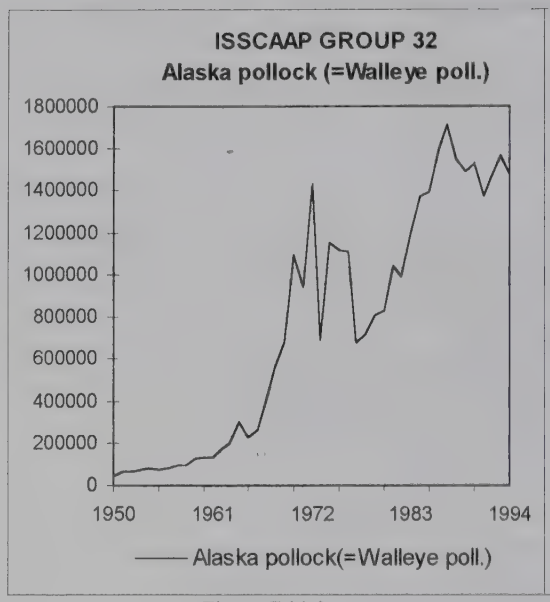


Figure B11.3

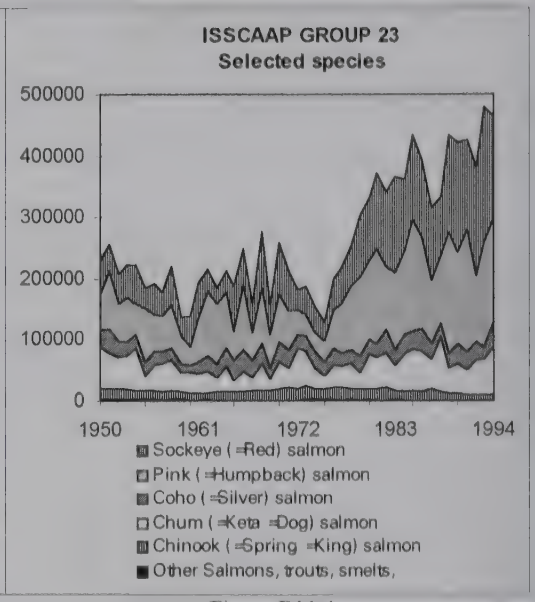


Figure B11.4

Roughly half of this decline was due to reduced landings of the most abundant fished species in the region, Alaskan pollock. Since the late 1960s catches of Alaskan pollock have made up the majority of ISSCAAP Group 32 catches and dominated the capture totals (Figure B11.3).

Another major contributor to this year's overall decline in catches was sockeye salmon, which declined by 51 895 t. During the latter half of the 1970s the catches of sockeye salmon had increased sharply and, along with similar increases in catches of pink salmon, resulted in total salmon catches during the 1980s and 1990s being twice as large as during the 1950s and 1960s (figure B11.4). This pattern in catches is due largely to improved growth conditions and increases in the size of certain salmon stocks. Catches of pink salmon in 1994 were virtually the same as in 1993, but overall regional landings of coho salmon increased in 1994 by 17 438 t, or roughly 77%.

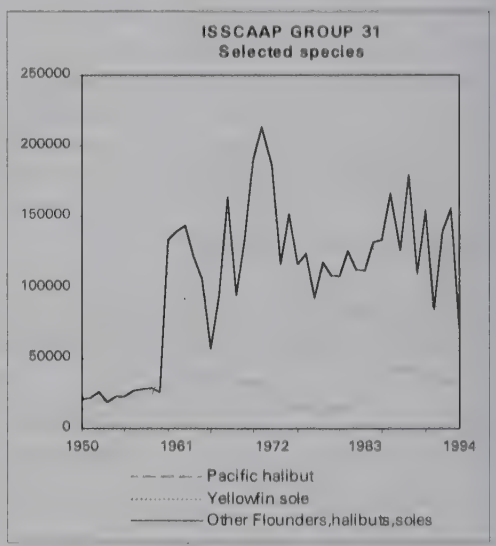


Figure B11.5

Large reductions in catches also occurred for flatfish (ISSCAAP Group 31) other than yellowfin sole, which declined by 85 855 t (figure B11.5) due to regulations designed to keep the overall groundfish catches within an estimated "optimum yield" limit and to minimize bycatch of North Pacific halibut and North Pacific snow and king crabs.

Other stocks for which landings declined significantly were Pacific Ocean perch, Pacific snow crabs, king crabs and Pacific shrimps (Figures B11.6 and B11.7). These declines were partially offset by an increase of 112 045 t in landings of North Pacific hake, a rise of nearly 80 percent (Figure B11.6). Pacific ocean perch were intensely exploited in the 1960s. Being a long-lived, slow-growing species, they are only now showing signs of rebounding from the over-exploitation of three decades ago. After increasing but variable catches throughout the 1950s and early 1960s, the catches of herring plunged by nearly 90% in 1964-65 and have remained at a lower level since (Figure B11.8).

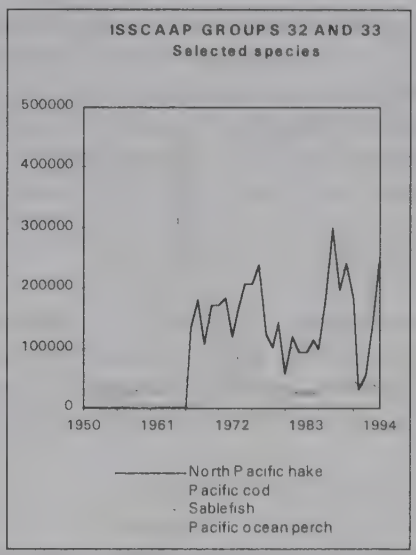


Figure B11.6

RESOURCE STATUS AND MANAGEMENT

Salmon Resources

Salmon resources in Area 67 are currently on an increasing trend overall. However, the opposite is true for the coho and chinook salmon stocks of the US Pacific coast which have been in decline. All species are considered fully utilized, except for chinook and coho salmon stocks of Washington, Oregon and California, which are considered overexploited. Canadian salmon stocks are starting to show declining trends. While Canadian catches are expected to improve in 1997 because of the cyclic nature of some stocks, it appears that there is a general trend towards catches that would be lower than in the 1980s. The trend is most apparent for southern stocks of most species, but particularly sockeye and pink from the Fraser River. The period since the mid-1960s has generally been a period of strong population growth which is reflected in strong growth in landings to an all time peak in 1993.

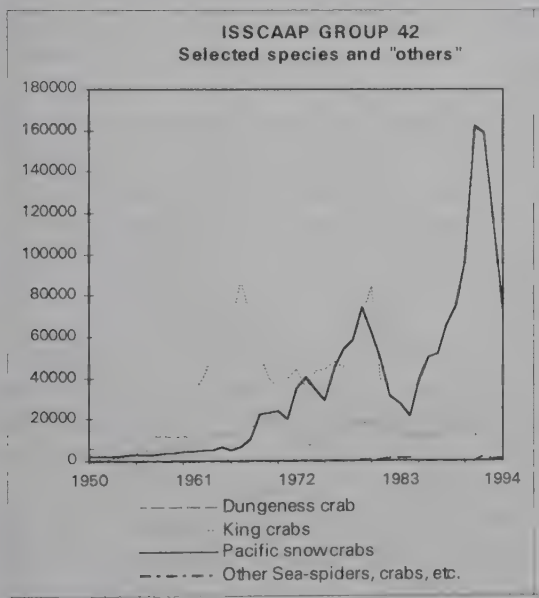


Figure B11.7

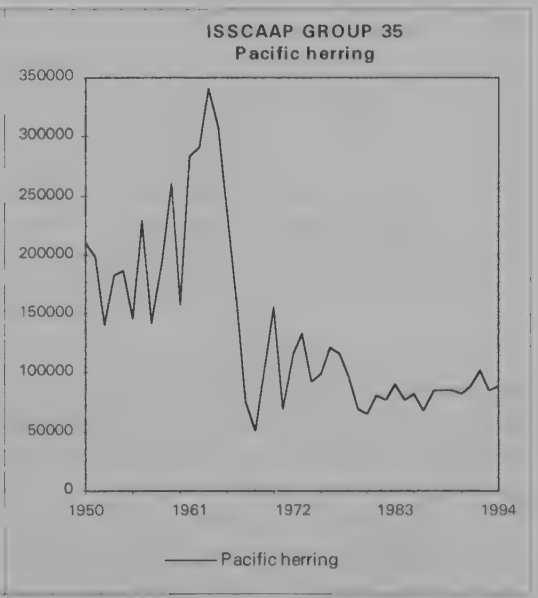


Figure B11.8

In spite of being near overall historical highs, salmon stocks face increasing pressure from environmental problems, and many of the stocks are already severely impacted. Being anadromous spawners, salmon reproduction is strongly affected by riverine and estuarine habitat degradation caused by logging, mining, oil and gas development, industrial development and urban expansion. Resulting conflicts with other economic sectors make mitigation difficult. Also, large numbers of salmon are caught as bycatch in the groundfish fisheries, another source of conflict and concern. There is also concern that use of hatchery production to help compensate for habitat loss may lead to the destruction of wild stocks.

In summary, chinook and coho salmon are considered overexploited in the California Current region but fully exploited at an appropriate rate off Alaska. Pacific cod is considered to be fully utilized in the Gulf of Alaska, but under-utilized in the Bering Sea, where its abundance is increasing; conversely off British Columbia, Pacific cod abundance is very low, resulting in closures.

Groundfish Resources

Many of the most important groundfish stocks of the North Pacific Ocean followed the same pattern of rapid increase, beginning in the mid-1970s, that marked the large salmon stocks of the subarctic Pacific. Accordingly, the largest groundfish population of them all, the complex of Alaska pollock stocks, held the distinction of being the largest fished population in the world, although in recent years the Peruvian anchoveta has regained this honor.

The Alaskan pollock is considered to be fully utilized. There are four main stocks recognized. Of these, the Eastern Bering Sea stock and the Aleutian Island stock are believed to be at moderately high abundance levels. The Aleutian Basin stock was diminished greatly by exploitation in the international "donut hole" and all fishing was stopped in 1993. The Gulf of Alaska stock has been declining in recent years due to poor recruitment.

The other large gadoid populations in the area, Pacific cod and Pacific hake (also called Pacific whiting) have followed a similar pattern, rising from the mid-1970s to mid-1980s but generally declining thereafter. Currently, Pacific cod abundance is high. It is considered to be fully utilized in the Gulf of Alaska but under-utilized in the Bering Sea where since 1994 the large eastern Bering Sea stock is believed to be increasing in abundance. However, off British Columbia, Pacific cod abundance is very low, resulting in total closures. Pacific hake is considered to be fully utilized. While the largest stock of Pacific cod is in the Bering Sea, Pacific hake is concentrated in the area off the US and Canadian west coasts. Contrary to the Pacific cod, Pacific hake abundance is apparently continuing to decline, currently reaching substantially lower levels than had been available to support the record catches of 1994.

Of the important flatfish populations, the very valuable Pacific halibut resource is considered to be fully utilized although stocks exhibit a general declining trend. Canadian quotas for Pacific halibut remain high despite a decline in individual size. The largest flatfish stock in is the Bering Sea yellowfin sole population. This population followed a pattern similar to that of the salmon and gadoids in increasing rapidly during the 1970s and early 1980s, but while the gadoids have declined after the mid-1980s the yellowfin sole abundance has stayed high. Yellowfin sole is considered to be under-utilized. Flatfish other than halibut and yellowfin sole are abundant and are under-utilized in the Bering Sea and Gulf of Alaska due to bycatch restrictions.

Sablefish is fully utilized throughout the region; Canadian stocks are believed to be healthy but declining. Groundfish stocks off the US Pacific Coast are considered to be fully utilized.

Crab and shrimp resources are at low levels throughout Alaska. However, in Canadian waters, landings and landed value of shellfish continue to increase as new species are added to the list of commercial fisheries.

Small Pelagics

Pacific herring support an extremely valuable fishery, much of it for high-valued roe. In general, since the mid-1970s herring seem to fluctuating in a low to moderate abundance state. The abundance trends vary among the numerous stocks in the region. But overall, the very recent trend is for fairly healthy levels of abundance. In the Bering Sea, where the stocks are believed to be at moderate levels, a portion of the stock, now limited by regulation to 1 000 t, is taken as bycatch by the groundfish fishery. Also the stocks in the Gulf of Alaska are believed to be at moderate abundance levels. Off Canada, herring abundance in the Strait of Georgia remains close to historic high levels. The abundance in the other areas is either average or close to cut off levels. The stocks off the west coast of Vancouver Island are in low abundance, apparently for natural reasons.

12. WESTERN CENTRAL PACIFIC

FAO Statistical Area 71

INTRODUCTION

Figure B12.1

This FAO Statistical Area (Figure B12.1) extends from the seas of the Southeast Asian countries down to north and east Australia and further eastwards to the smaller island countries of the South Pacific (as discussed in the regional review of the South Pacific Islands). The area is dominated by a large continental shelf area, which is bordered in the north by southeast Asian countries and in the southeast by Indonesia and Australia. The majority of this shelf area lies within the EEZ's of Southeast Asian countries, reflected in the major contribution these countries make to the total production of Area 71. In 1994 catches by Indonesia, Malaysia, Philippines, Thailand and Vietnam accounted for 97% of the total. The shelf areas are rich in demersal resources, including penaeid shrimps, and small pelagic resources, while the oceanic waters of the Pacific have rich tuna resources.

Development of fisheries in the region has been much influenced by the global market. This has been reflected by the rapid development of trawl fisheries in southeast Asia in 1970s targeting

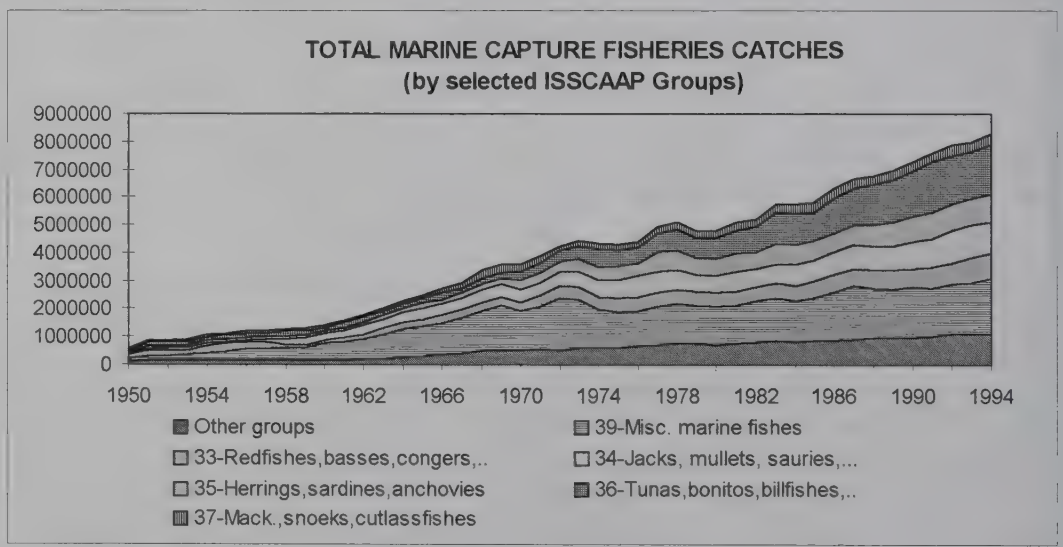


Figure B12.2

shrimp for export, the relatively fast development in the early 1980s of purse seine fisheries targeting tuna for canning, and of tuna longlining since mid 1980s targeting tuna for the fresh sashimi market. The decline in wild shrimp catches and the resulting shortfall in demand resulted in the development of shrimp culture since mid-1980s.

Despite the rapid development of fisheries in this region, the level of knowledge of the status of resources is inadequate. Many management decisions have been made on an *ad hoc* basis and only in some cases have management measures been based on advice from the scientific community. The situation is of course different in the southern part of the region, where scientific advice has been an integral part of the management process in most of the Australian fisheries for some time.

PROFILE OF CATCHES

Total catches in the area have risen almost continuously since 1950, although the rate of increase has flattened since 1990 (Fig. B12.2). No single ISSCAAP group can be singled out as the key factor in explaining variation in (Table XII) total catches. In 1994 the top seven ISCCAAP species groups (by catches) accounted for 87% of the total. The top seven were, in order of catch share: ISSCAAP Groups 39 (miscellaneous fishes); 36 (tunas); 34 (jacks); 35 (herrings); 33 (redfishes); 37 (mackerels), and 45 (shrimps). The typical multispecies nature of tropical coastal resources seems to be reflected by the high proportion of the miscellaneous group and the relatively even spread of catches between the other ISSCAAP Groups. Although lower than in the Eastern Indian Ocean, the contribution of miscellaneous fishes is still high and accounted for 24% of the total landings in 1994. The higher rate of catch increase in the later years for this group may very well be explained by augmented fishing pressure in coastal waters.

The patterns of catch share by different species within ISSCAAP Groups 34, 35 and 37 are all similar, with a few species standing out. For example, various scads make up ~50% of the catches within ISSCAAP Group 34 (jacks, mullets, sauries, etc.) (Figure B12.3). The

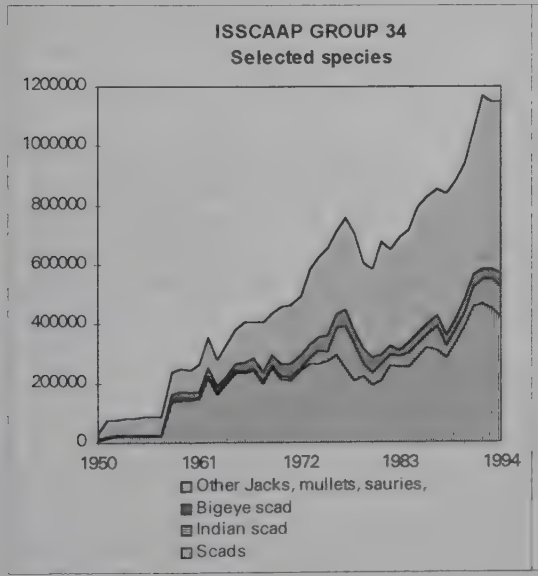


Figure B12.3

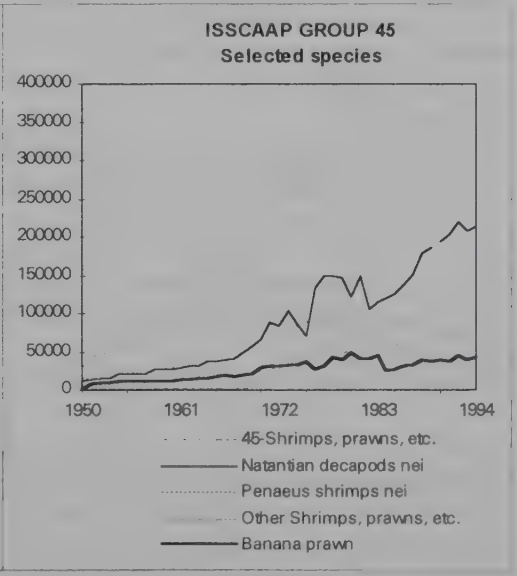


Figure B12.4

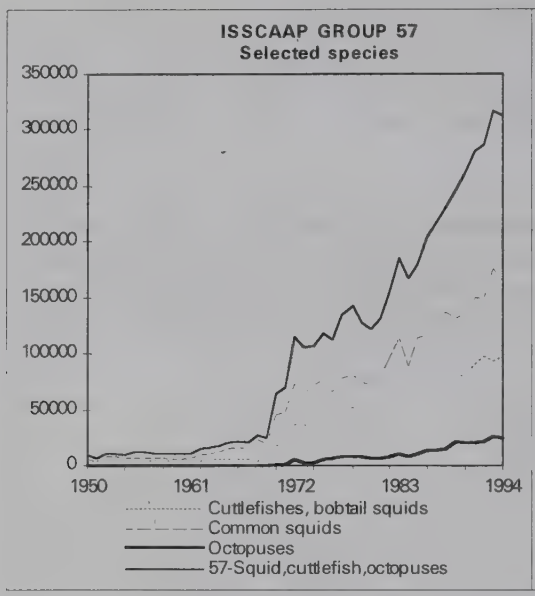


Figure B12.5

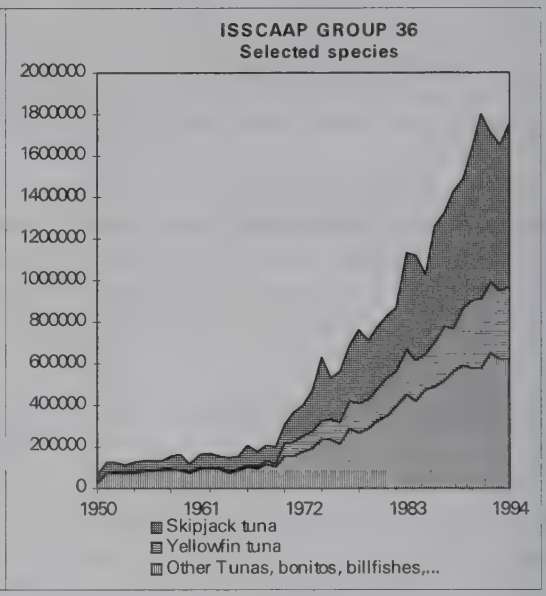


Figure B12.6

ISSCAAP Groups 35 and 37 are similarly dominated by catches of Sardinella species and Indian mackerels *(Rastrelliger spp.)* respectively (Table XII).

Coastal fisheries are still dominant in the major fishing countries. Shrimp are a main target of these fisheries, with the banana prawn as the most valuable species. The majority of the catch is made up of unspecified Natantian decapods and other shrimps and prawns (Figure B12.4). While shrimp exports from capture fisheries have been relatively constant, if not declining, those from aquaculture have increased and overtaken them. The preferred cultured species is the tiger prawn, *P. monodon,* due to its sturdiness and relatively large individual size.

The catch of cephalopods has increased from 165 000 t in 1984 to 270 000 t in 1994 (Figure B12.5). Thailand contributed about 43%. Some resources are still lightly exploited in some Indonesia waters and in a limited part of Vietnam waters, and there could be potential for further development.

Tunas are an important export commodity for the area. Catches for export are made primarily by distant-water fishing fleets, with the major species being skipjack and yellowfin (Figure B12.6). Much of the coastal tuna catch comes from other species and is for domestic consumption. Total tuna catches by the distant water fishing fleet in 1994 was of the order of 600 000 t, as contributed by Japan, Korea Republic, USA and Taiwan (Province of China). China, as a relative newcomer to the fishery, landed 10 000 t in 1994.

RESOURCE STATUS AND MANAGEMENT

Despite the continued increase of catches in the major fishing countries, strong indications of overfishing exist for some species in coastal waters. For instance, the abundance of demersal fish stocks in the Gulf of Thailand in the early 1990s was only one tenth of the 1960s level when the trawl fisheries started. The shrimp resources in the Arafura Sea seem to have experienced increased fishing pressure in the 1990s, with an increase in the number of small trawlers operating in the northern part of the Arafura Sea. Coastal tuna resources in the

Philippines waters continued to decline, which encouraged expansion of tuna fishing in Indonesian waters through bilateral arrangement.

Various conventional management measures have been introduced by countries in the region (including closed seasons, closed areas or zoning, mesh-size regulations etc.). However, fishing pressure has kept increasing. Increases in human populations seems to be an important factor for many countries. Despite impediments in the buyback scheme that Malaysia introduced in 1985, the country is presently initiating a second try to reintroduce the scheme in its effort to reduce fishing pressure in coastal regions. Relatively lower fishing intensity is typical in the southern part of the region (Australia, New Zealand, and some small island States in the South Pacific). The management of fisheries in the southern part of the region seems to show encouraging results, and although northern areas may have different resources and different fisheries management structures, countries to the north could learn from this experience.

The main environmental problems in the region arise from a combination of high population pressure in coastal areas and poor facilities for waste treatment, as indicated by the high level of coli bacteria in some coastal areas. More environmental problems appear in the developing countries in Southeast Asia, although fishing with cyanide for ornamental fish has decreased to some degree in the region. However, the high prices for live food fish from the coral reefs (such as groupers and snappers) have led some fishers to return to cyanide fishing again. Concerns over environmental issues relating to fisheries have received special attention among academics and research scientists of the region, as reflected in discussions during the recent Asia-Pacific Fisheries Commission (APFIC) Symposium on Environmental Aspects of Responsible Fisheries, held in Seoul, 15-18 October 1996. The need to strengthen fisheries management, including the promotion and implementation of integrated coastal area management, formed one of the recommendations of the symposium.

13. EASTERN CENTRAL PACIFIC

FAO Statistical Area 77

INTRODUCTION

This Statistical Area covers fishery resources and fisheries off the western coastline of the Americas from northern California, USA, to southern Panama (Figure B13.1). It has a total extension of 48.90 million km^2 and a total shelf surface of 0.81 million km^2. Most of the continental shelf is narrow, and hardly extends more than 20 km from the coastline, except for some areas off San Francisco Bay, El Salvador, Nicaragua and the Gulf of Panama, where it widens to as much as 60 km. The bottom tends to be heterogeneous, with several areas suitable for trawling, although there is not much trawl fishing except for shrimps. Trawling for coastal demersals is very limited, and deep-water trawling is almost non existent. There are a few small coastal islands off southern California and Panama, and other island groups in oceanic waters. These island chains, of which the largest one is Hawaii, also have very narrow continental shelves.

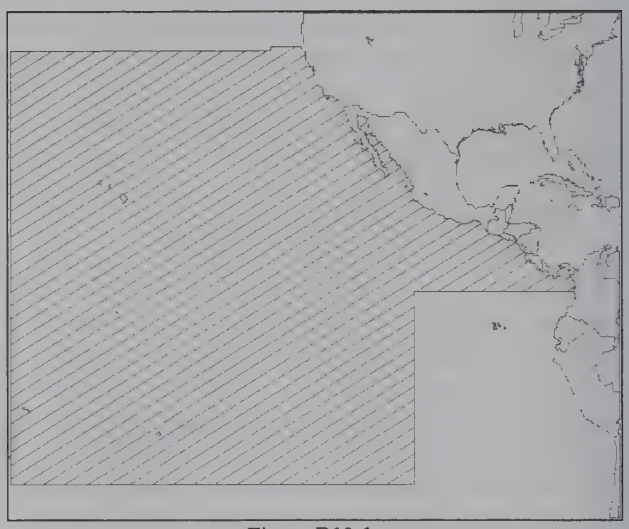


Figure B13.1

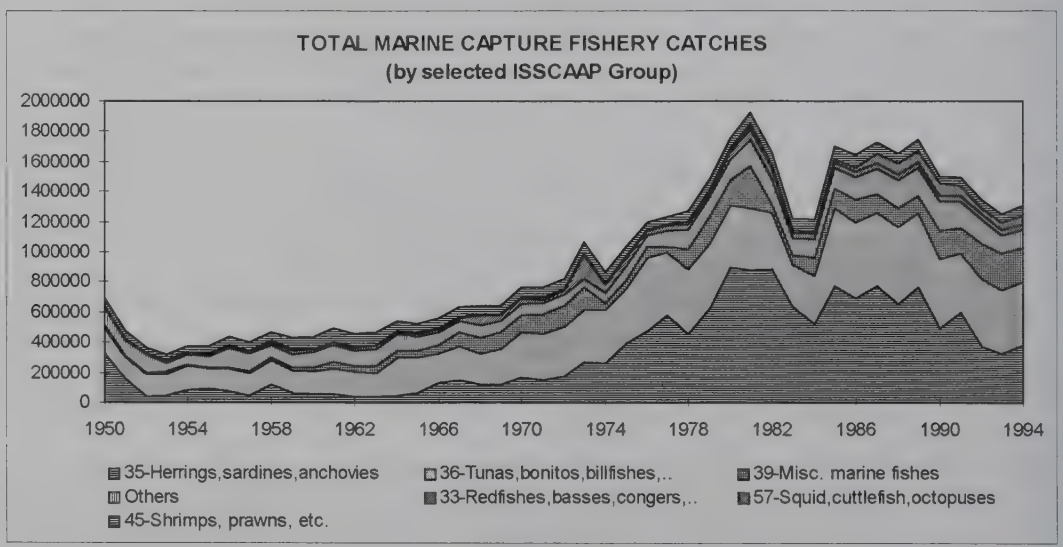


Figure B13.2

The area is under the influence of two major surface current systems, the California Current in the north and the Equatorial Current in the south. The interaction between current systems, the topography and the differences in wind stress generate major upwellings along the coast of California, Baja California, the Gulf of Panama, and some smaller upwellings along the Central American coast and offshore in the Costa Rica dome. While coastal upwelling tends to be particularly important in the northern, more temperate part of the area, coastal runoff tends to be another major source of coastal water enrichment along the more tropical areas off Central America. These characteristics strongly influence the abundance and distribution of fishery resources and fishing activities. Fishing for small and large pelagics is particularly important at or around the major upwelling areas, and fishing for shrimps and, to a lesser extent, for coastal demersals sustain major local fisheries in the more tropical areas off Mexico, Central America and Panama.

PROFILE OF CATCHES

In 1994 the total production per shelf area was 1.67 t/km^2. This rather high value is mostly due to the production of small and large pelagics, some of which don't have their life histories restricted to the neritic shelf area. When only shelf-dependent species are considered, the total production per shelf area drops to 0.74 t/km^2, which is still amongst the highest overall value for a tropical and sub-tropical shelf area. As with the total catches, historic and current production per shelf area come mostly from pelagics, followed by much lower volumes of squids, shrimps and coastal demersals. Pelagic fisheries are particularly important off southern California, Baja California, the Costa Rica dome and the Gulf of Panama. Although shrimp catches are limited, their high unit value makes shrimp fishing the other major commercial fishery in the area and the main one in most of the coastal countries in the area.

Some pelagic fisheries were already quite developed in this area during the first half of this century, particularly off California. Total catches of tunas were in the order of 150 000 t per year prior to the 1950s, and catches of California pilchard (or sardine) (*Sardinops sagax caeruleus*) reached peaks well over 700 000 t in the 1930s and early 1940s. In those years the total accumulated production from this area rose to peaks around 900 000 t but, after some very good years, total catches dropped sharply to a record low of 320 000 t in 1953. Most of this was caused by the bloom and collapse of the California sardine fisheries off the USA.

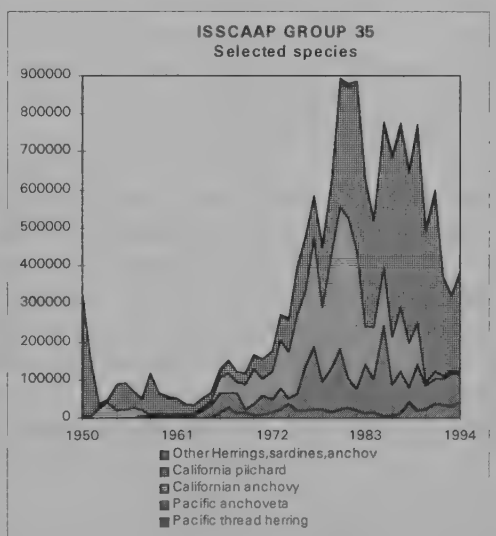


Figure B13.3

Since 1953 total catches for the whole area had a sustained rate of increase, peaking at 1.9 million t in 1981. Since then total catches and catches by major species groups have been very variable and with a general decreasing trend, although from 1993 to 1994 the total production increased slightly from 1.27 to 1.33 million t (Fig. B13.2, Table XIII). While most of the recent year-to-year variability and decreasing

trend in total production has been due to the changes in the abundance and overall production of small pelagics, it is noteworthy that the strong 1983-84 "El Niño" caused a severe drop in total catches of almost all species groups.

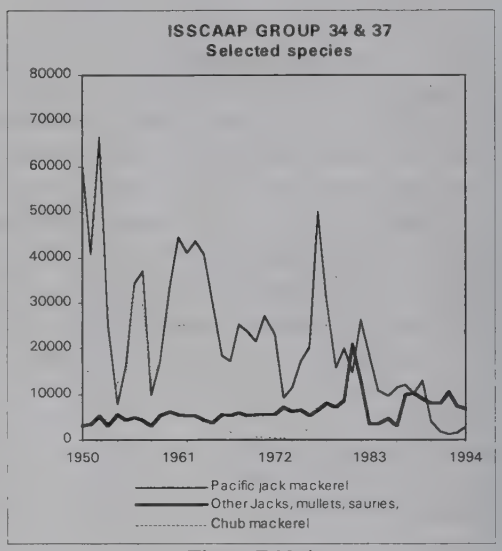


Figure B13.4

From the total resource base point of view, the collapse of the California pilchard (sardine) fishery off California in the late 1940s was compensated by an increase in the abundance of California anchovy (*Engraulis mordax*) in the same general location, although no substantial fishery for this species developed until much later. It was only by the 1970s that Mexico developed a major industrial fishery for California sardine and California anchovy, which contributed to increase the total production of small pelagics in Group 35 from the record low of 36 000 t in 1952, to a peak of almost 900 000 t in 1980 (Fig. B13.3). Total catch of small pelagics in this ISSCAAP Group then declined with some year-to-year variability to only 323 000 t and 387 000 t respectively in 1993 and 1994. Most of this recent decline is due to the reduced abundance and lower catches of California sardine, and particularly of California anchovy. Catches of California sardine dropped from 509 000 t in 1989 to 194 000 t in 1993, to increase slightly to 266 000 t in 1994. However, in recent years the most dramatic change in overall abundance and production has been that shown by the California anchovy. Catches of this species dropped from a peak of 424 000 t in 1981 to the record low of 3 900 t in 1994.

Other important small pelagics of ISSCAAP Group 35 in this area are the Pacific anchoveta (*Cetengraulis mysticetus*) and the Pacific thread herring (*Opisthonema libertate*), caught mostly off Panama. Catches of these two species are highly variable. The maximum recorded catch of Pacific anchoveta was 241 000 t in 1985, followed by low values of the order of 39 000 and 62 000 t in 1988 and 1990, and 72 000 t in 1994. The maximum recorded catch of Pacific thread herring was 40 000 t in 1988, followed by 18 000 t in 1989 and a new high of 41 000 t in 1994 (Figure B13.3).

The other main small pelagic species in this area are the Pacific jack mackerel (*Trachurus symmetricus)* in ISSCAAP Group 34, and the chub mackerel (*Scomber japonicus*) in ISSCAAP Group 37. These two resources have sustained important fisheries off the USA since the beginning of the century. In the available statistics (Fig. B13.4) catches of Pacific jack mackerel peaked at 66 000 t in 1952 but have been highly variable, with a clear decreasing trend in recent years. Very low catches of 1 200 to 2 700 t have been reported between 1992 and 1994. Catches of chub mackerel have also been very variable, with more prolonged periods of high and low catches. Observed high catches peaked at 67 000 t in 1935, 34 000 t in 1956 and, more recently, at 78 000 t in 1990, following a period of almost negligible catches in the early 1970s.

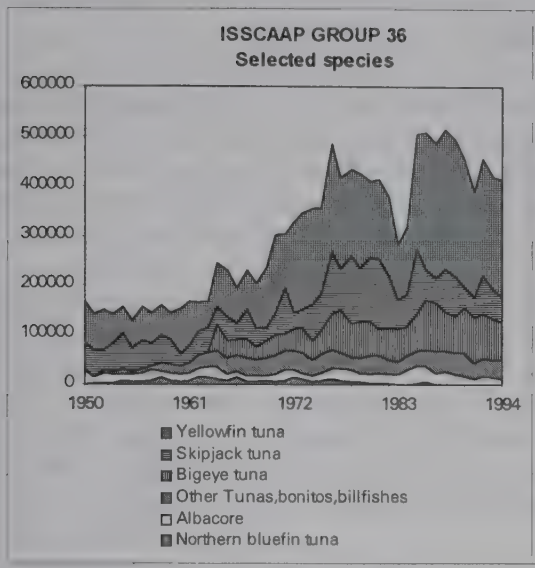


Figure B13.5

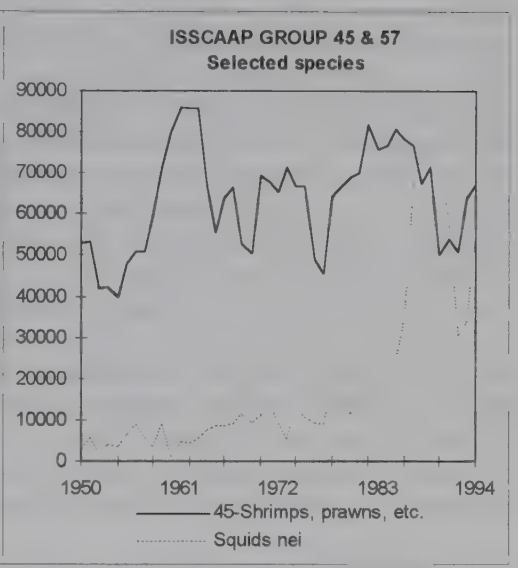


Figure B13.6

Tunas and other large pelagics are an important group with an extended distribution in the area. Their total production had a sustained and fast rate of increase until the 1970s, and has been increasing slightly with some fluctuation in the range of 283 000 t to 516 000 t per year over the past two decades (Figure B13.5). In 1994 the total catch of this species group was 413 000 t. In the region, the main fishing countries are Mexico and USA. Other principal countries fishing here are Venezuela, Japan, Rep. of Korea and other Asian countries. The main species are the yellowfin tuna (*Thunnus albacares*), which over the past few years has been yielding relatively stable catches of the order of 210 000 t to 280 000 t per year, with 234 000 t in 1994, and the bigeye tuna (*Thunnus obesus*), that has been yielding total catches of 70 000 t to 100 000 t per year, with 77 000 t in 1994. Catches of skipjack tuna (*Katsuwonus pelamis*) and albacore (*Thunnus alalunga*) are also important and have been relatively stable, with total reported catches of 52 000 t and 12 000 t respectively in 1994.

Shrimps and prawns sustain particularly valuable and important fisheries throughout the area. Total production of this species group has been increasing almost steadily to a maximum of 100 000 t in 1994, but most of the recent increase is due to the expansion of aquaculture production. Total shrimp catches have been more or less stable, ranging in recent years between 50 000 t (in 1990) and 80 000 t (in 1985) per year (Fig. B13.6). It is noteworthy, however, that these represent the accumulated catches of a large number of stocks and 7 to 10 species (mostly *Penaeus spp*) that individually tend to be more variable but are not properly identified in most of the available landing statistics. Catches of squids have also been variable. After a rapid increase to a peak at 75 000 t in 1988, total catches of squids decreased to 30 000 t in 1992 to increase to 56 000 t in 1994 (Fig. B13.6). Although not specifically identified in the landing statistics, a good share of what is reported as squids nei for this area is currently the jumbo flying squid (*Dosidicus gigas*).

There is no ongoing directed fishery for deep-water demersals in the area, and most of the reported catches of other more coastal demersals (mostly in ISSCAAP Group 33) are taken by small local fleets. Nevertheless, the effective fishing effort actually directed on to these stock is very limited, and the reported catches are frequently of by-catches from the shrimp fisheries.

RESOURCES STATUS AND MANAGEMENT

Tunas and squids in this area are exploited both by local fleets and by long-range fleets from different nations, while most other fisheries are exploited by local fleets from nations bordering the area. Except for tunas, which are assessed and managed through multinational efforts, and some bilateral or regional research activities on other species groups, so far of limited duration and scope, most fisheries in the area are assessed and managed through national initiatives.

The Inter-American Tropical Tuna Commission (IATTC) based in La Jolla, California, has a long lasting tradition and experience in assessing and managing the main tuna stocks, and while not all countries in the area are members, it is still the main regional organization devoted to fisheries research, assessment and management of tunas in the Eastern Central Pacific. Several bilateral programmes addressing fisheries assessment and management issues have been executed in the past, and some are still ongoing between the USA and Mexico, particularly with respect to small and large pelagics in the California and Baja California area.

There have also been a series of regional research activities covering fish stocks and fisheries further south, off Central America and Panama. Several of these activities have been conducted or are still going on under regional cooperation programmes with the technical and/or financial assistance of one or more international, regional or sub-regional organizations, such as EC, FAO, NORAD, OLDEPESCA, PRADEPESCA and UNDP. While in some cases scientific progress has been achieved through these fisheries research and assessment programmes, less has been accomplished in terms of fisheries management. In this respect, it is worth noticing that, as of 18 December 1995, all the Central American countries created a new regional fisheries organization, the "Organización del Sector Pesquero y Acuícola del Itsmo Centroamericano" (OSPESCA) that has the development and management of fisheries in the area as one of its main objectives.

As far as more specific assessments and management-related information is concerned, it is noted that very few research efforts have been devoted to studying the deep-water demersals of ISSCAAP Groups 32 and 33, which, besides being poorly studied, are also almost unexploited in this area. There are, however, no indications that particularly abundant stocks of these species groups might exist in the area. Coastal demersals, mostly in ISSCAAP Group 33, are in most cases moderately exploited if one considers their directed fisheries, but tend to be heavily to over-exploited by the shrimp fisheries, where demersal fish frequently represent a large proportion of the by-catch, especially as juveniles.

It has been already reported that, within ISSCAAP Group 35, the total catches and overall abundance of California sardine and California anchovy have been very variable and are currently down to fairly low levels. The California sardine seems to be well below its maximum historical abundance levels, and while off Mexico is probably fully exploited, it is currently underexploited off the USA. The California anchovy is seriously depleted, after being fished heavily for several years off Mexico, and very lightly exploited or under-exploited off the USA. Although these two species have been subject to heavy exploitation rates in same parts of their distribution range, the recent declines in overall abundance and total production seem to be related to a large extent to natural "regime" changes also reported for similar species elsewhere (see later special topic on "Global synchrony in fish population variations").

The Pacific anchoveta stock has also been very variable, as reflected by the annual catches by Panama, where it sustains a major industrial fishery. This stock is probably moderately to fully exploited. Pacific thread herring is only reported in substantial quantities by Panama, where there is a directed fishery for this species. In the past, a small fleet from Costa Rica used to also target on Pacific thread herring, but this species now mostly shows up in incidental catches throughout the area. This stock is probably moderately exploited off Panama and under-exploited elsewhere in its distribution range.

Other small pelagics in ISSCAAP Groups 34 and 37 are only moderately exploited, while most tunas within ISSCAAP Group 36 are considered to be fully exploited.

Amongst the invertebrates, there are some deep water shrimps (mostly *Galatheidae*) within ISSCAAP Group 44 which are virtually unexploited, while most, if not all, the main wild stocks of shrimps and prawns in ISSCAAP Group 45 are either fully or over-exploited, with several giving clear signs of stock depletion. Still within the invertebrates, squids (ISSCAAP Group 57) seem to also be relatively abundant in the area but are virtually unexploited, or underexploited in some areas.

14. SOUTHWEST PACIFIC

FAO Statistical Area 81

INTRODUCTION

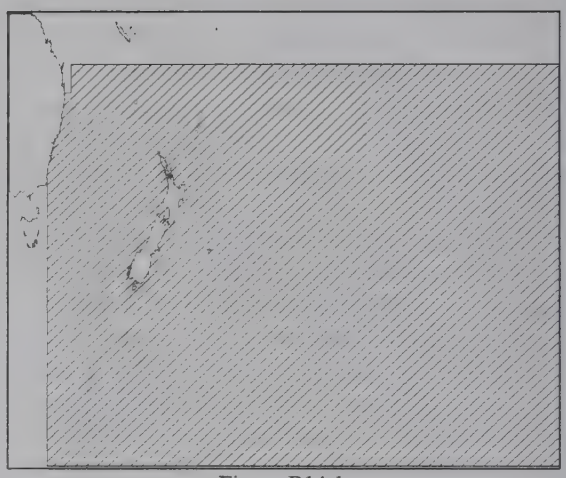


Figure B14.1

This area encloses the Tasman Sea and the Pacific Ocean east to the 105°E meridian (Figure B14.1). The types of habitats that are exploited in this area are most varied, from coastal continental fisheries to deepwater seamount fisheries. In fact, New Zealand has been a pioneer in profitable and sustained deepwater (>600 m) trawl fisheries. The fisheries resources consist of the coastal species of the Australian States of New South Wales and Northern Victoria, and of New Zealand, the pelagic resources of the South Western Pacific and the mesopelagic species (of which the most important are orange roughy and hoki) associated with the sea bottom rises of the Tasman Sea, and to the south and east of New Zealand and the deep water to the west of the South Island.

A development of interest in this area began with the industry-sponsored exploratory surveys for orange roughy in areas to the southeast of New Zealand. These surveys were noteworthy as they required cooperation between otherwise competing companies. This had the benefit of spreading the risk of the venture in the event that no new resources were located. As it was, previously unknown resources of this species were discovered. Another event of considerable regional interest was the outbreak of a viral disease that caused massive mortalities of pilchard

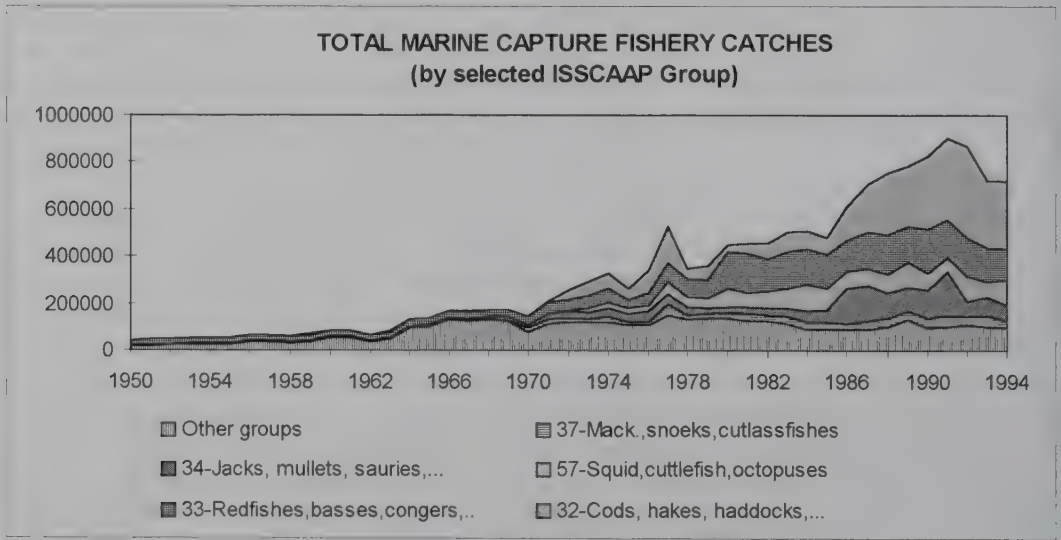


Figure B14.2

(*Sardinops neopilchardus*). This epidemic started in the Australian Bight, spreading to Western Australia and to Queensland, taking about 70 days to spread 6 000 km. The outbreak then appeared in New Zealand in June 1995. This epidemic was mostly specific to adults over 9 cm with the event happening quickly, over a period of a couple of weeks. Mortality could be patchy with apparently healthy schools among those that had been afflicted. The cause seems to be a herpes virus.

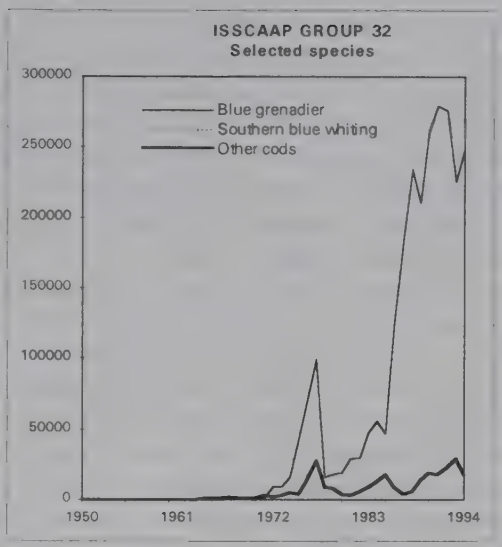


Figure B14.3

PROFILE OF CATCHES

Catches within the Southwest Pacific region increased relatively slowly up until the end of the 1960s. The relative isolation of Australia and New Zealand meant fisheries production was largely for domestic consumption only, where demand was low due to the traditional market preference, and low prices, for red meat. The main species caught during the 1950s and 1960s were the New Zealand dredge oysters, golden snapper, tarakihi and red rock lobster, all caught by New Zealand. These four species made up over 40% of total landings until 1970. Smaller quantities of cupped oysters and mullets were landed by Australia. In 1970 significant landings of species from other ISSCAAP Groups were first reported. By the mid 1970s catches of species from what are now considered the main ISSCAAP Groups had already trebled, and catches in total more than doubled. This rate of increase continued, with catches of the main ISSCAAP Groups nearly doubling every five years until 1991, at which point declines in catches of several of the Groups occurred (Figure B14.2, Table XIV).

One of the main "new" ISSCAAP Groups in the 1970s was Group 32 (cods, hakes, haddocks, etc.), with the main species being Southern blue whiting and blue grenadier (or hoki) (Figure B14.3). Catches of hoki peaked at 279 000 t in 1991, declined sharply in 1993 but rallied to 248 000 t in 1994 (with over 80% being caught by New Zealand). Catches of Southern blue whiting peaked in 1992 but have since declined to levels close to the average of the 1980s (~18 000 t).

The main species of the other dominant finfish ISSCAAP Groups are the oreo dories, orange roughy, greenback horse mackerel and snoek (Figure B14.4). While the catches of oreo dories have remained relatively constant throughout the late 1980s and early 1990s, the catches of snoek

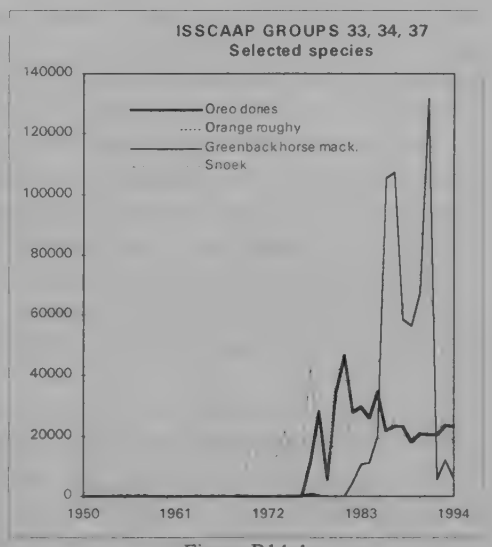


Figure B14.4

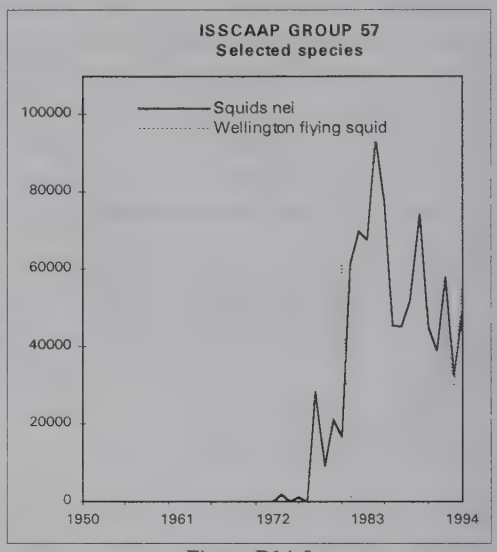


Figure B14.5

have declined by 40% from the 1993 peak and are now at their lowest level since 1979. However, the major variation in catches has come from orange roughy and greenback horse mackerel. The first catches of orange roughy (5 000 t) were reported by 1979 in New Zealand (which has remained the main harvesting nation). Catches climbed quickly to ~40 000 t by the early 1980s, before another sharp increase in the late 1980s saw catches peak at ~90 000 t in 1990. Since this peak, catches have declined by over 50% and catches in 1993/94 are back at around the 40 000 t level seen in the first half of the 1980s. The species showing the greatest variation in landings is greenback horse mackerel, with a 90% reduction in landings between 1991 and 1992 (132 000 t and 6 000 t respectively). The catches of this species since 1991 have been lower than those seen in the second year of the fishery in 1983. All the catches of greenback horse mackerel were taken by the USSR (countries of the ex-USSR after 1987). Harvests of squid species (ISSCAAP Group 57) also started in 1972, with catches of Wellington flying squid collapsing in 1981 (from 63 000 t to 1 000 t) before picking up again and increasing, albeit with large variability to date, reaching a new peak of 58 000 t in 1994. Catches of other species have shown a downward trend since peaking at 94 000 t in 1984.

RESOURCE STATUS AND MANAGEMENT

New Zealand

Thirty seven species are under quota management in the 1995-1996 fishery season. The Fisheries Act of New Zealand requires that, in respect of yields, management consider "The amount of fish ... that will produce from that fishery the maximum sustainable yield, as qualified by any relevant economic or environmental factors, fishing patterns, the interdependence of stocks of fish, and any generally recommended sub-regional or regional global standards". The assessment strategy uses an objective of Maximum Constant Yield (MCY). This is defined as "the maximum constant catch that is estimated to be sustainable, with an acceptable level of risk, at all future levels of biomass". MCY will depend on the current state of the fish stock: if the biomass falls below a certain level, the MCY would be reduced. The other management reference point used is that of Current Annual Yield (CAY). This is obtained by applying a reference fishing mortality, F_{ref}, to the estimate of the biomass.

Many factors are taken into account before setting a Total Allowable Commercial Catch (TACC), and the TACC may be higher than would be indicated by the MCY or CAY. These factors include fishing patterns, the interdependence of stocks, non-commercial interests (e.g. Maori, traditional and recreational) and other relevant economic and/or environmental factors. For example, hoki catches have been lower than that which the stock is believed capable of supporting because it is thought that higher landings would result in fewer economic benefits being derived from the fishery.

With its entry into the New Zealand quota management system, stocks of red rock lobster (nine management units) have shown some signs of future possible recovery which has been reflected in the value of their quota rights. Landings for the 1994/95 season were 2 624 t, compared with 5 024 t in 1986/87. While stocks of the highly valuable orange roughy, the foundation of the export industries, continue to decline, this decline has been offset to some extent by the continuing discovery of new stocks and stocklets. Little is known about the relation between these apparent stocks. During the 1994-95 season, only 81.7% of the quota was taken for a catch of 22 449 t, down from a peak of 62 474 t for the 1988/89 season.

Another species gaining increasing prominence in export sales is blue grenadier (or hoki), which is managed in two stock units. At the industry's initiative (for marketing reasons) catches taken have been less than that believed to correspond to the sustainable yield. Only 79.4% of the quota was taken during the 1995-96 season for a total of 174 972 t, compared with 251 893 t during the 1989-90 season. The current size of the western stock is much larger than that which will support the MSY and it can sustain the current catch level. For 1995-96, the estimate of the (CAY) is much larger than the current catch level, which indicates that higher yields are possible from this stock. For both the current catch level and TAC increase of 100 000 t (with an increase of 75 000 t from the western stock), there appears to be zero risk to the stock and fishery from 1995 to 2000. For the eastern stock the assessment is less certain and the management model results are sensitive to most parameters. However, the current biomass appears to be above the level needed to maintain MSY, and the CAY is about the level of commercial catches. The risks associated with the fishery are unknown but would be reduced if harvesting were switched to the Western stock.

Australia

Being a country with a state-federal structure, Australia has two levels of fisheries management; traditionally States controlled the territorial waters (up to 3 miles offshore) and the Commonwealth Government controlled resources in the offshore (up to 200 miles). Many of the stocks in the Australian EEZ in Area 81 (i.e. essentially New South Wales) are shared with Queensland to the north (in FAO Statistical Area 71), particularly lutjanids and shrimp (eastern king prawn). About 25% (48 000 t) of fishery landings in the Australian EEZ in Area 81 are under Commonwealth control. These fisheries are managed under the Fisheries Management Act 1991 by the Australian Fisheries Management Authority. In terms of offshore fisheries, the general region of Area 81 contains the following: the East Coast yellowfin tuna fishery; the East Coast skipjack tuna fishery (resource probably underexploited with a declining catch trend); Southern bluefin tuna (overexploited with catches controlled by quota); Southern shark (schooling sharks overexploited, gummy sharks fully exploited); Southeast fisheries for eastern gem fish and orange roughy, the first being fully exploited, the second at or near full exploitation, and a Southeast fishery for 14 quota species of which only one is considered under exploited.

Total allowable catches were placed on silver gemfish in 1988 and on orange roughy in 1990. TACs were introduced for all 16 major species or species groups in the Southeast fishery in 1992. Prior to this time the fishery had been characterized by fleet over-capacity and effort leading to over exploitation of the species. Current catch from the fishery is around 23 300 t. Apart from silver gem fish and orange roughy, the most important species are flathead (*Neoplatycephalus richardsoni*), blue grenadier, and redfish (*Centroberyx affinis*). The

Southeast fishery is shared among NSW, Victoria, Tasmania and South Australia. Since 1985 it has been compulsory for participants to keep log records by tow. Flathead have been a component of this fishery since trawling began and peak catches were recorded in 1928 (>5 000 t); current landings are around 1 150 - 3 800 t. High-grading may be a problem in this quota-controlled fishery. Redfish are a slow-growing species reaching more than 35 years of age. Problems have occurred with stocks straddling areas under state jurisdiction, and these have been compounded by growth overfishing and discarding of small individuals. Current biomass may be less than 30% of the unfished level and stock rebuilding is considered necessary.

The silver gemfish stock has been in decline since the late 1980s, largely as a result of poor recruitment during 1985-89. As a consequence, a zero TAC was set in 1993 which has since remained in place, and trip limits exist for gemfish bycatches. Despite the reductions in landings, the stock continues to decline as weak year classes pass through the fishery. For the other major trawl-caught species, orange roughy, stock biomass is now believed to be 25-35% of the unfished level and harvests must be reduced if the fishery is to be sustainable. The uncertainty regarding the stock structure of this species complicates its management. The extreme longevity of this species (~100 years) means that stock rebuilding will be a lengthy process.

15. SOUTHEAST PACIFIC

FAO Statistical Area 87

INTRODUCTION

This Statistical Area has a total extension of 30.02 million km^2 off the western coast of South America, from northern Colombia to southern Chile, and includes a total continental shelf surface of 0.57 million km^2 (Figure B15.1). The continental shelf is rather narrow with a steep slope throughout most of the Area, except for some limited zones off southern Ecuador, northern Peru and southern Chile, where the shelf might reach a maximum width of 120 km. The main oceanic islands in this Area are the Galapagos Islands off Ecuador and Juan Fernandez and Easter Islands off Chile. Areas suitable for bottom trawling can be found off northern Colombia, Ecuador, northern Peru and central and southern Chile, but the best and most productive trawling areas are in northern Peru and southern Chile.

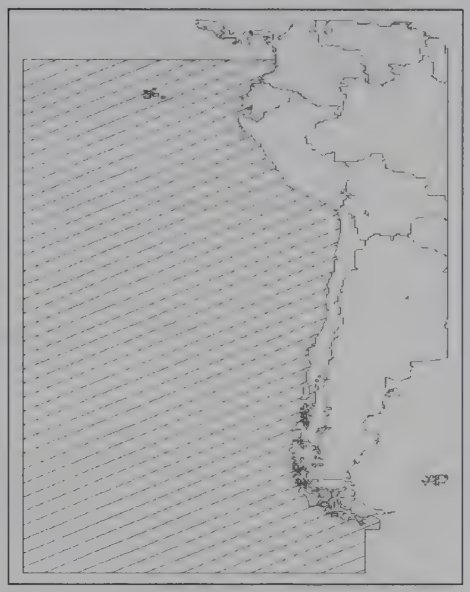


Figure B15.1

The northern part of the Area, off Colombia and Ecuador, has a tropical climate typical of low latitudes, with mean sea surface temperatures and salinity around 28°C and 33‰ respectively, and relatively low productivity. Further south, off Peru and northern and central Chile, the coastal areas are dominated by the Humboldt-Peru eastern boundary current system, which generates the cold nutrient-rich coastal upwelling that makes this region so productive. Even if close to the Equator, water masses close to these

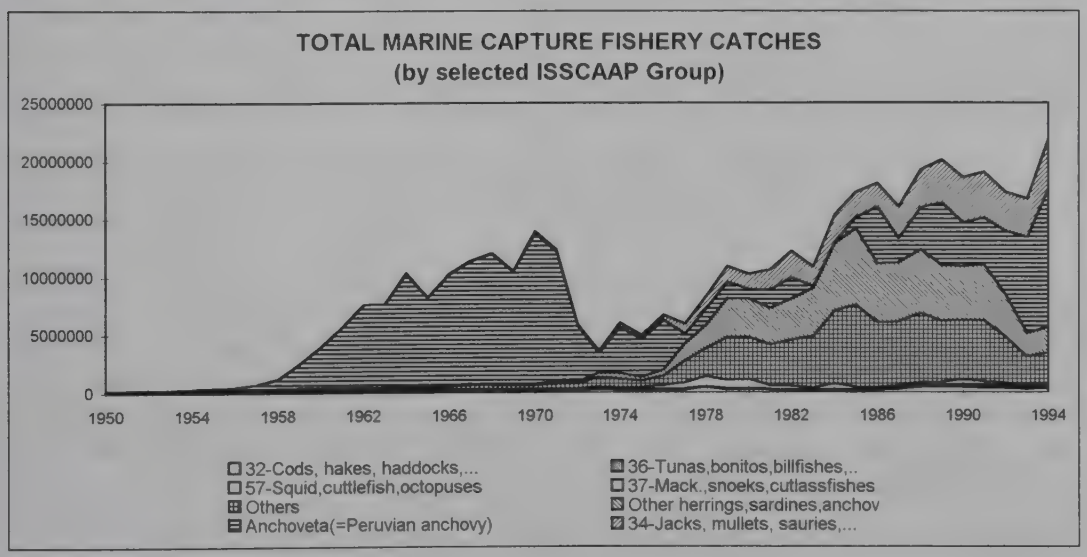


Figure B15.2

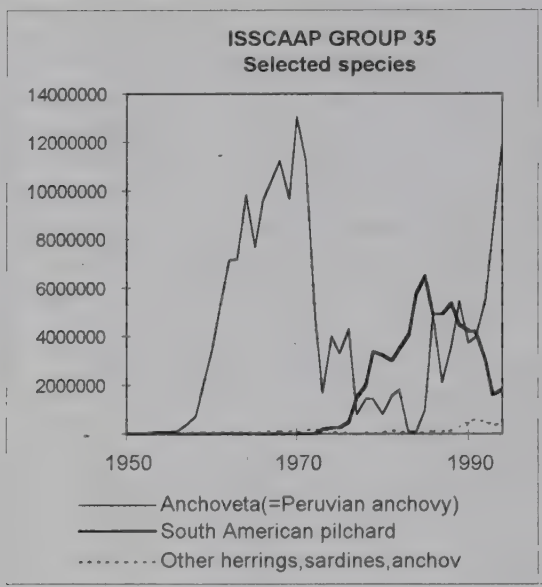


Figure B15.3

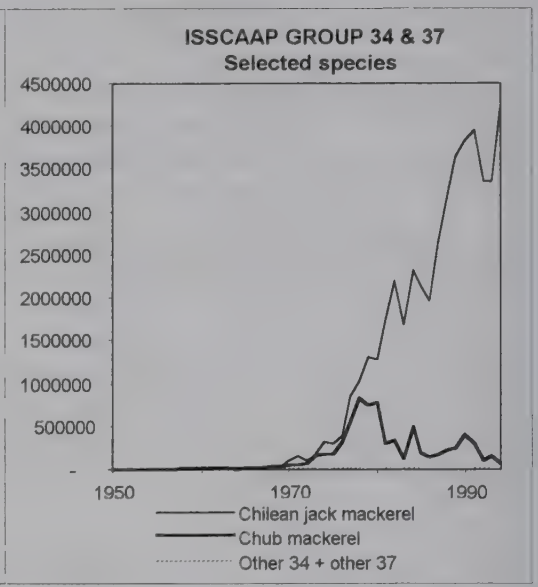


Figure B15.4

coastal upwelling areas have low sea surface temperature, usually ranging from 14 to 20°C, with surface salinity in the order of 35‰. Further south, off southern Chile, water masses are much colder and turbulent but still highly productive, with sea surface temperatures well below 14°C and high salinity, around 44‰.

The distribution and abundance of fishery resources and the development of fisheries are strongly influenced by the prevailing environmental conditions. While shrimps, small coastal pelagics and large tropical migratory pelagics sustain the main fisheries off Colombia and Ecuador, small pelagics are by far the dominant species off Peru and northern and central Chile, with demersals becoming the most important fisheries further south.

The impact of changing environmental conditions is particularly noted in this area, causing large year-to-year fluctuations as well as longer-term changes in fish abundance and total production of the main exploited species. Well known are the adverse effects of the "El Niño" phenomenon on the abundance of the Peruvian anchoveta (*Engraulis ringens*), the once depleted and now recovering largest single-species fishery of the world. The not always negative impact of the "El Niño" phenomenon on other marine populations, including other small pelagics, hakes, shrimps, cephalopods, shellfish, sea birds and marine mammals are also worth noting.

Recent resource changes of particular relevance in this area are the severe depletion of the South American sardine (or pilchard) (*Sardinops sagax sagax*) and the impressive recovery of the Peruvian anchoveta, that, after the record low catch of 94 000 t in 1984, is again yielding total catches that are closer to the "pre-collapse" 8 to 10 million t per year. Worth noting are also the increases in total catches of Chilean jack mackerel (*Trachurus symmetricus murphy*) and squids (mostly jumbo flying squid, *Dosidicus gigas*) that are the other major contributors to the most recent overall increase in total production in the area.

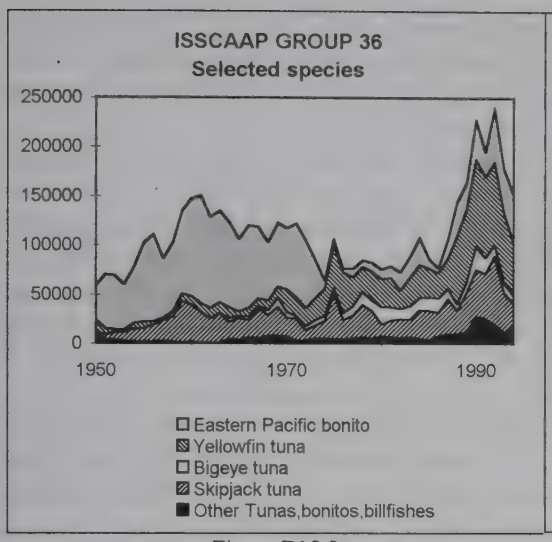


Figure B15.5

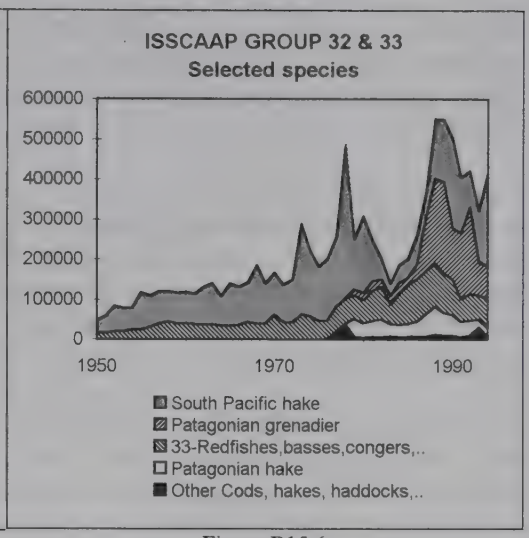


Figure B15.6

PROFILE OF CATCHES

Fish production in the Southeast Pacific has experienced large changes and fluctuations over the past four decades. From 167 000 t in 1950, total fish production increased to 13.8 million t in 1970, declined to 3.2 million t in 1973, and increased to a new record of 19.8 million t in 1994. All this with large year-to-year fluctuations and major shifts in the species composition of mostly small pelagics, such as anchovies, sardines, herrings, and jack and chub mackerels (Figure B15.2) (Table XV). While small pelagics clearly dominate the fishery scenario in this area, noticeable changes have also occurred in other species groups, particularly hakes and other demersals, and more recently squids. To a great extent, the reported variability in the abundance and species composition in this area is caused by changing environmental conditions, often associated with changes in the "El Niño" Southern Oscillation (ENSO).

Total production in this area was and is still dominated by the Peruvian anchoveta, the major component of ISSCAAP Group 35 (herrings, sardines, anchovies, etc.) in Area 87 and world-wide. Until the early 1970s most of the year-to-year reported fluctuation in total production from this area has been due to changes in the abundance and resulting catches of this species.

After reaching the record high of 13.1 million t in 1970, the total catch of Peruvian anchoveta fell to a record low of 1.7 million t in 1973 and to a further low of 94 000 t in 1984. Since then the stock has been recovering, and the total catches have increased again to 11.9 million t in 1994 (Figure B15.3). Other small pelagics, such as the South American sardine (pilchard), the Chilean jack mackerel, and the chub mackerel (*Scomber japonicus*), that were producing previously negligible catches (of the order of tens of thousand tonnes per year), started increasing after the Peruvian anchoveta fishery collapsed in 1972-73. Since then, the South American sardine (pilchard) and, more recently, the Chilean jack mackerel, became major components of the total fish production in this area.

The South American sardine (pilchard) is the second contributor to the total production of ISSCAAP Group 35 after the Peruvian anchoveta (Figure B15.3). Catches of the South American sardine increased from less than 10 000 t per year prior to 1970 to 3.3 million t in

1979 and to a maximum of 6.5 million t in 1985. Then catches declined to 1.6 and 1.8 million t in 1993 and 1994 respectively, apparently as a consequence of heavy fishing combined most likely with an environmentally-driven long-term "regime change" in abundance (see also Special Topic section on Global synchrony in fish populations).

Other main species in ISSCAAP Group 35 are the Araucanian herring (*Strangomera bentincki*) and the Pacific thread herring (*Ophisthonema libertate*). Catches of these species have also been highly variable. The Araucanian herring had two distinguishable periods of high production, one between the mid-1960s and mid-1970s, with peak catches of 159 000 t and 183 000 t in 1971 and 1974, and a more recent one that started in 1989 and a record high catch of 584 000 t in 1991.

The increase in the abundance and distribution range of the Chilean jack mackerel (ISSCAAP Group 34) is also worth mentioning. Prior to 1970 there was no evidence of this stock being so abundant, and the annual catches were hardly over 30 000 t per year (Figure B15.4). However, in the early 1970s this species started to appear consistently as by-catch in local artisanal and industrial fisheries, and then more specialized Chilean, Peruvian and ex-USSR fishing fleets began targeting on it in the mid 1970s and 1980s. Catches increased to almost 4.0 million t by 1990 and to more than 4.2 million t in 1994. Another main small pelagic in this area is the chub mackerel in ISSCAAP Group 37 (Figure B15.4). Catches of this species were in the range of 10 to 30 000 t per year prior to 1970, had a rapid increase to 836 000 t in 1978, to decrease to 79 000 t in 1994.

Although grouped here with the larger highly migratory tunas within ISSCAAP Group 36 (Figure B15.5), the Eastern Pacific bonito (*Sarda chiliensis*) also used to support an important coastal small pelagic fishery in the area. Catches of this species were on the order of 60 000 t per year in the 1950s and 1960s, with a peak catch of 109 000 t in 1961. Following the collapse of the Peruvian anchoveta (its main food source), catches of Eastern Pacific bonito dropped to 4 300 t in 1976 but are now recovering to almost 50 000 t in 1994. Catches of yellowfin tuna (*Thunnus albacares*) were also increasing in the area, to 88 000 t in 1990, but then dropped to 53 000 t by 1994. Catches of skipjack tuna (*Katsuwonus pelamis*) have been variable, between 10 000 t (in 1972) and 69 000 t (in 1992) per year, with 23 000 t in 1994.

Amongst the demersals, the main species are the South Pacific hake (*Merluccius gayi*) and more recently the Patagonian grenadier (*Macruronus magellanicus*) and the Patagonian hake (*Merluccius polylepis*). Catches of these and other demersals in ISSCAAP Groups 32 and 33 have been increasing for several years but, after peaking at 550 000 t in 1988, their total catch dropped to 320 000 t in 1993, with a slight increase to 415 000 t in 1994 (Figure B15.6).

A major increase has also been reported in the total catches of squids in ISSCAAP Group 57 (Figure B15.7). Catches of this species group increased from less than 10 000 t prior to 1989 to

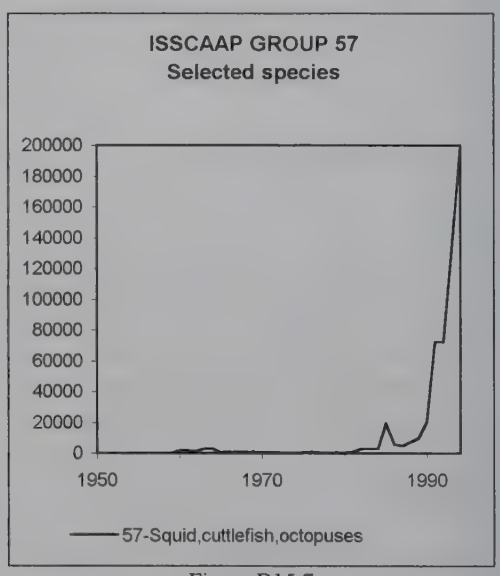


Figure B15.7

almost 200 000 t in 1994, mostly due to increased catches by Korean, Japanese and Peruvian fleets. The individual squid species are not always identified in the official catch records from this area but there are indications that most of it is the jumbo flying squid (*Dosidicus gigas*).

RESOURCE STATUS AND MANAGEMENT

As mentioned before, this area is well known for experiencing large changes in the abundance and species composition of the main exploited fish resources. This tends to have major social and economic impacts at national and regional level and, moreover, since the area is a major contributor to world fish production (almost 22% of the 1994 world marine production came from the Southeast Pacific), the effects of these changes are usually evident even when more general world fisheries trends and projections are considered.

Within the region, the Peruvian anchoveta, the South American sardine and the Chilean horse mackerel complex provide a most striking example of how these changes in abundance and species composition can affect local fisheries and national economies. Within this group the most studied species is the Peruvian anchoveta, and it is estimated that, while highly variable, at times it has reached peak total biomass levels of well over 20 million t. Based on an over-optimistic perception of fish abundance provided by peak non-sustainable catch rates, the fishery expanded rapidly and, during several consecutive years, managed to remove a total annual catch of this single species well in excess of the recommended ceiling of 8 to 9 million t per year, with peak catches of 13.1 and 11.2 million t in 1970 and 1971, just prior to its collapse.

While it is recognized that heavy fishing did play a major role in the collapse of the Peruvian anchoveta fishery in the early 1970s, it is also true that the 1972-73 "El Niño" was a primary cause of recruitment failure and stock decline. The lack of adequate management action to drastically reduce fishing pressure did the rest, contributing to aggravate and prolong the decline. The anchoveta stock was already depleted and catches were already fairly low when the much stronger 1982-83 "El Niño" hit the area. That's why the 1982-83 "El Niño" didn't have such a severe impact on the total regional fish production, although it did reduce the Peruvian anchoveta stock to its historical minimum. The fortunate coincidence of favorable environmental conditions and controlled fishing allowed the stock to recover and catches to increase. The two sub-stocks of Peruvian anchoveta are now reported to be fully to heavily exploited and, given their known high natural variability and poor resilience to heavy fishing, particular monitoring and control measures need to be adopted to prevent overfishing.

The South American sardine (pilchard) is considered to be fully exploited, although it might have been over-exploited in part of its distribution range and had virtually disappeared from some areas. Total biomass and total production of this species has been going down since the mid 1980s, and all seems to indicate that this is due to a combination of heavy fishing and an environmentally-driven long-term "regime change" in overall abundance (see also Special Topic section on Global synchrony in fish populations).

Fishing pressure on the Chilean jack mackerel has been building up fairly rapidly in part of its distribution range and, although fishing in other areas is still limited and total biomass levels are reportedly high, the stock can be considered to be moderately to fully exploited, with increased probability of becoming over-exploited if the expansion of fishing in some areas is not

controlled. Due to its extended coastal and oceanic distribution, proper management of this fishery might require some kind of tighter regional cooperation.

The eastern Pacific bonito seems to be recovering and is probably moderately exploited in most of its distribution range. Yellowfin tuna is probably fully exploited, while most of the other tunas and the chub mackerel are moderately exploited. Other small pelagics, such as the Araucanian herring and Pacific thread herring are most likely fully to heavily exploited in most of their distribution range.

Amongst the demersals, the South Pacific hake has also shown large recruitment variability associated with "El Niño" type of changes in environmental conditions. Catches of South Pacific hake have been increasing over the past few years as a consequence of environmental factors and increased fishing pressure, and the stocks are considered to be fully to heavily exploited. Other demersals such as the Patagonian grenadier, the Patagonian hake and some toothfishes and congers are most likely fully to heavily exploited, with some of them giving signs of over-exploitation.

Catches and fishing pressure on squids, particularly on jumbo flying squid, has also been building up rapidly in the area but, due to its ample distribution range, the stock is probably still moderately exploited. Amongst the other invertebrates, tropical as well as more temperate water shrimps tend to be fully to heavily exploited, while sea urchins, clams, scallops and other shellfishes have been over-exploited and even depleted in some areas, while they are moderately or very lightly exploited in other areas.

Except for tunas and other highly migratory species, and for the Chilean jack mackerel prior to 1992, all the main fish stocks in this area are exploited by national fleets operating within their own EEZs or by land-based foreign fleets operating under some kind of licence or fisheries agreement with a coastal state. This to some extent simplifies the assessment and management of fisheries as well as the allocation of responsibilities for the conservation and use of living marine resources in the area. In fact, while there is a more regional approach as far as the assessment and management of tuna fisheries is concerned, all other major fisheries in the area are assessed and managed at national level. Nevertheless, there is a well-established tradition of regional cooperation regarding general fisheries research issues, and coastal states might cooperate with neighboring and/or distant-water fishing countries on a case-by-case basis when dealing with the assessment and management of fish stocks that extend well beyond their own EEZs.

Most of the tuna fisheries in the area are assessed and managed by the Inter-American Tropical Tuna Commission (IATTC) that applies a combined scheme of fishing effort controls, catch quotas and close seasons to regulate fishing in its area of influence, which includes and extends well beyond the north-western part of Area 87. Together with the IATTC, other regional organizations such as the Permanent Commission for the Southeast Pacific (CPPS) and the Latin American Organization for the Development of Fisheries (OLDEPESCA) have been exploring alternatives to modify and expand the existing arrangements for the assessment and management of tunas and other highly migratory species in the wider eastern Pacific area.

The CPPS, of which the four coastal states facing Area 87 are members, plays an active role in dealing with regional marine issues, including coordinating activities regarding regional and international legislation, research and training, oil pollution, environment preservation,

oceanography and fisheries. Other international, regional or sub-regional organizations such as the EC, FAO, IATTC and OLDEPESCA also support or have supported regional or sub-regional efforts on research, assessment and management of fisheries in the region.

Most of the main fisheries in the area are under some kind of national fisheries management scheme, although their efficacy and the amount of research and administrative efforts devoted to their implementation vary greatly with the type of fishery and from country to country. Limiting access through fishing licences or fishing permits, the setting of total annual catch quotas, closed seasons, closed areas and limiting the minimum size of fish caught are amongst the most frequent management tools that are used and are frequently combined by national fisheries management authorities to regulate fishing in their areas of influence.

16. SOUTH PACIFIC ISLANDS

FAO Statistical Areas 71 and 77

INTRODUCTION

Stretching across the eastern half of FAO Statistical Area 71 and the southern parts of FAO Statistical Area 77, there is a distinctive fisheries region encompassing Micronesia, Polynesia and Melanesia. The following review concentrates on this region, but certain parts may also be relevant to fisheries off adjacent Asian countries, northern and eastern Australia and Hawaii, USA.

The total area of land (0.5 million km^2) in the region is small compared with the entire area (approximately 30 million km^2). The EEZs cover 25.2 million km^2, from which 19.8 km^2 is accounted for by small island countries excluding Australia and New Zealand.

The small island countries support 5.25 million residents (67% in Papua New Guinea), who rely heavily on living marine resources as a source of food and foreign currencies from licence fees as well as exports. The average consumption of fish is about 50 kg per person per year, but reaches 250 kg in some atolls. This can be compared with 8 kg per person each year in a continental country such as Australia.

MARINE FISHERIES AND RESOURCE STATUS

The long time series FAO catch statistics used in the compilation of the (Profile of Catches) for other regions are aggregated by FAO Statistical Areas and therefore cannot be used where the region to be reviewed incorporates parts of one or more Areas, as is the case with the South Pacific Islands. The catches and resources status of the South Pacific island fisheries are

Tuna catches by fishing method and year in the SPC statistical area (data from SPC)

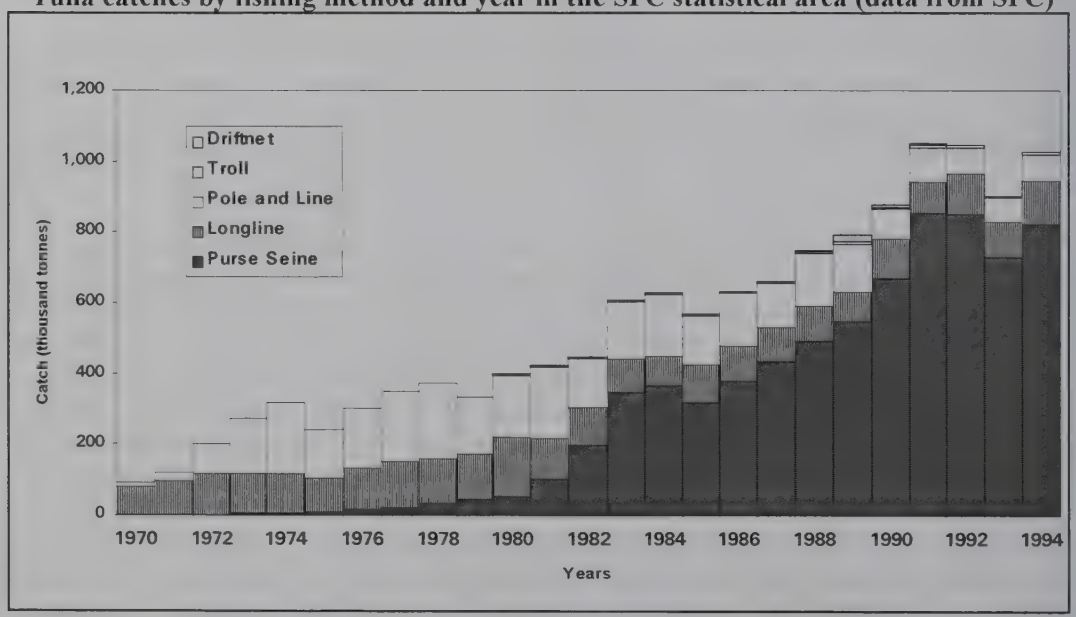


Figure B16.1

discussed below by major fishery type, followed by a discussion of management. In the South Pacific island region there are three main types of fisheries distinguished by their pattern of operation and the way they are administered by Pacific island nations: the industrial fisheries (mainly tunas); coastal fisheries for export (e.g. mother-of-pearl shells), and coastal fisheries for domestic consumption.

Industrial fisheries

Tunas are the target of the only significant industrial fisheries (purse seine, longline, pole and line, troll and, in the past, driftnet) off small islands in the South Pacific (see Fig. B16.1). They operate especially off Papua New Guinea, the Solomon Islands and Kiribati, but also off Vanuatu and Fiji (see Fig. B16.2) for the purse seine fisheries, which produce most catches. The fishing is carried out mainly by distant water fishing nations like China, Indonesia, Japan, Korea, Philippines, Taiwan (PC) and USA (see Fig. B16.3), which pay fees to gain access to South Pacific islands' Exclusive Economic Zones. In the 1970s and 1980s, few Pacific island nations were fishing for cannery-quality skipjack and albacore. Recently, their participation in tuna fishing has increased with the advent of small-scale longline fisheries for sashimi-quality yellowfin and bigeye tuna. These fisheries operate mainly off Federated States of Micronesia, Fiji, French Polynesia, Guam, Marshall Islands, New Caledonia, Palau and Tonga. However, Pacific island national fleets still take only 6.5% of the weight of tuna caught in the SPC statistical area. The species composition of tuna catches is given in Figure B16.4.

Distribution of purse seine fishing effort in the SPC statistical area (data from SPC)

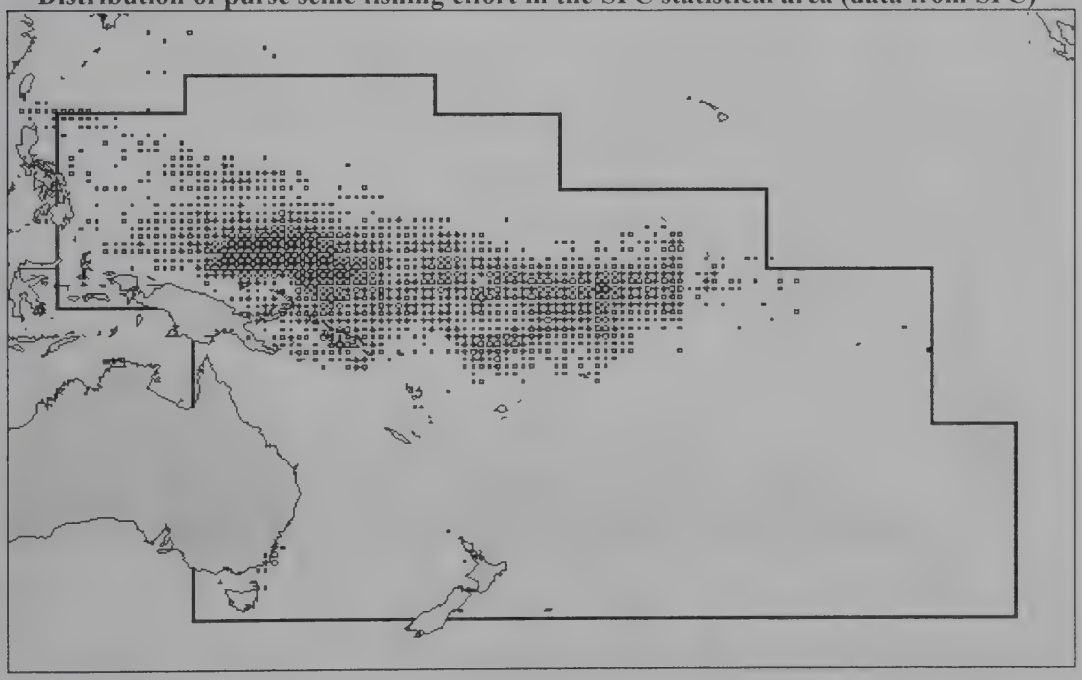


Figure B16.2

Tuna catches by country/territory in the SPC statistical area for 1994 (data from SPC)

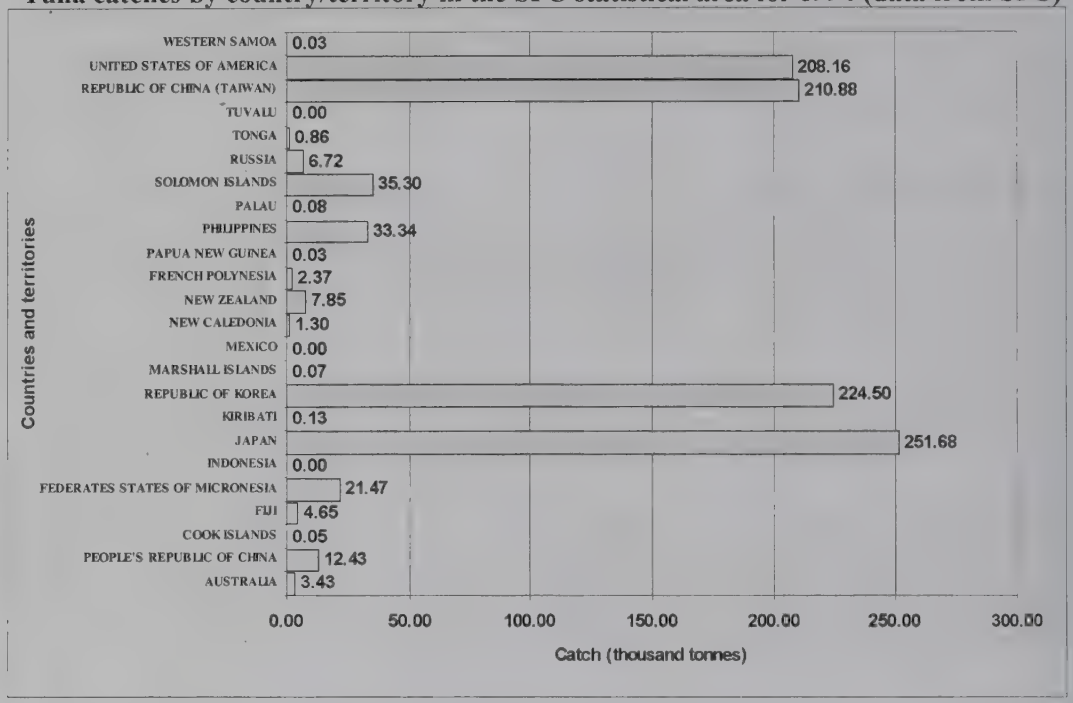


Figure B16.3

Tuna catches by species in the SPC statistical area (data from SPC)

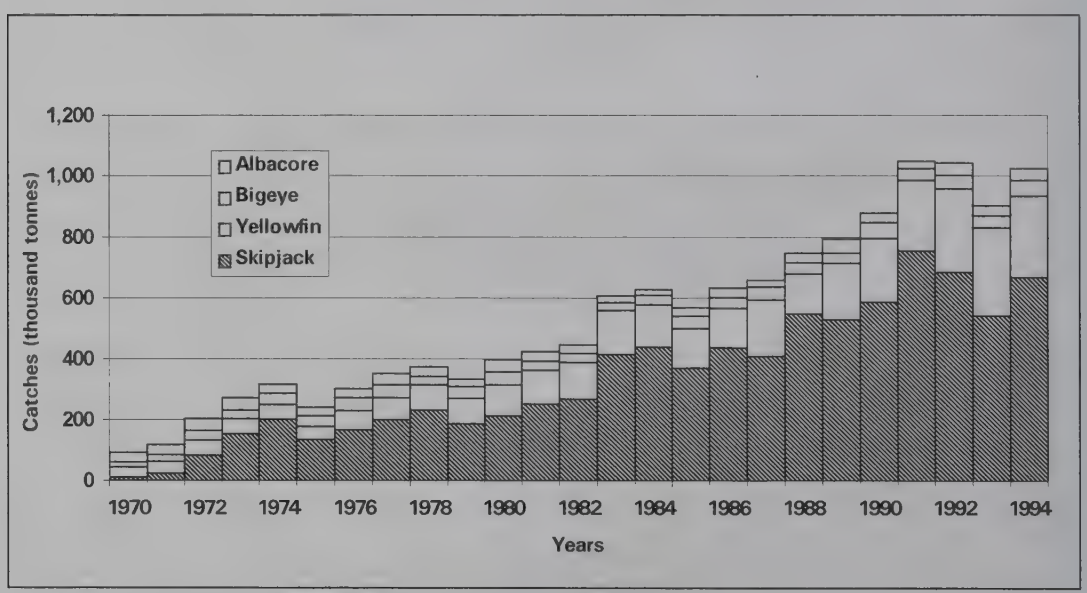


Figure B16.4

The tuna fisheries in the Pacific could probably sustain an increase over the current total catch (just over 1 million tonnes in 1994 for the SPC statistical area) by at least one third, provided fishing effort is well managed. However, at present, it may not be optimally distributed,

particularly for small longliners targeting sashimi-quality fish, where effort is concentrated in Micronesia, close to the main markets and flag States. Interactions between industrial and small-scale tuna fisheries are a major focus of management-oriented research at the moment.

There is also another small industrial fishery (trawl) catching around 2 000 tonnes of shrimps per year off Papua New Guinea.

Coastal small-scale fisheries for export products

South Pacific island nations do not export a great deal of fishery products from their coastal zones, and those exported are predominantly in the category of commodities aimed at very specific markets. Most small-scale export-orientated coastal fishing is carried out by Pacific islanders who sell their catches to middlemen or exporters of often foreign origin and capitalisation. Exploitation is often driven by the occasional availability of commercial exporters in the area, resulting in a characteristic pulse fishing. Chief amongst the exported products, in terms of volume (see Fig. B16.5), are dried sea-cucumbers (still known as "beche-de-mer" in Melanesia and "trepang" in Micronesia), of which the vast majority are consumed by Chinese-speaking people. Mother-of-pearl shells (*Trochus niloticus*, *Pinctada margaritifera*, *Turbo marmoratus*, in decreasing order of volume) are also exported for natural shirt buttons and, to a lesser extent, traditional furniture inlays (see Fig. B16.6).

Recently, with improving transport, the export of certain species of chilled and live fish is becoming important, at least in terms of value and impact on stocks, although the deep-slope eteline snapper fishery has given way, in most cases, to small-scale tuna longlining.

Exports of beche-de-mer (in dry weight) by year from New Caledonia (data from SPC)

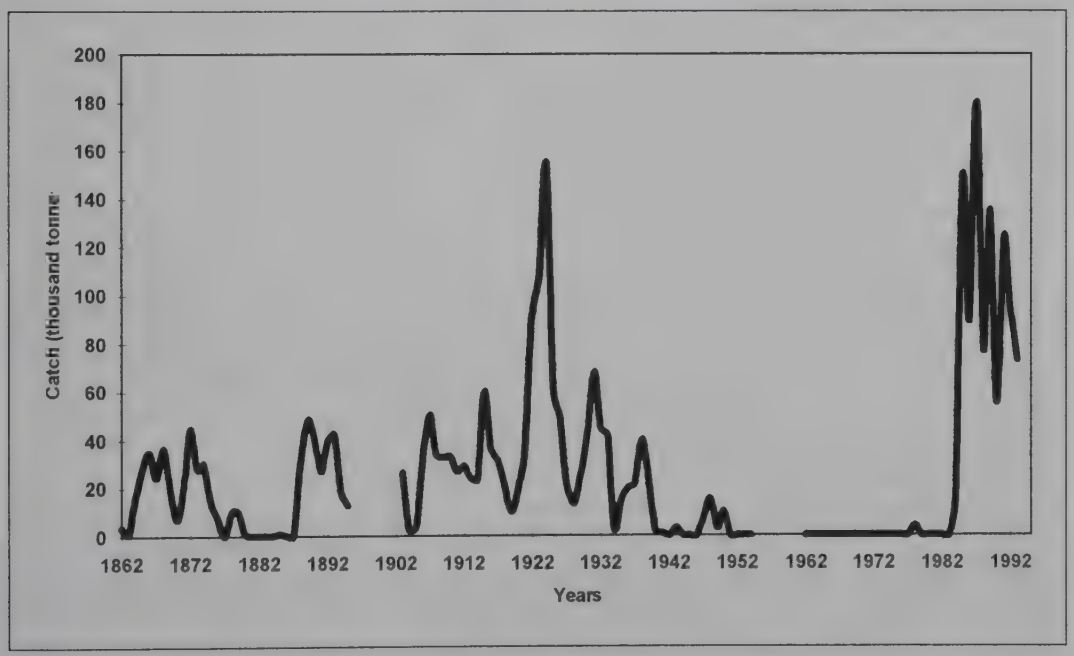


Figure B16.5

Exports of trochus shell by year from Palau (data from SPC)

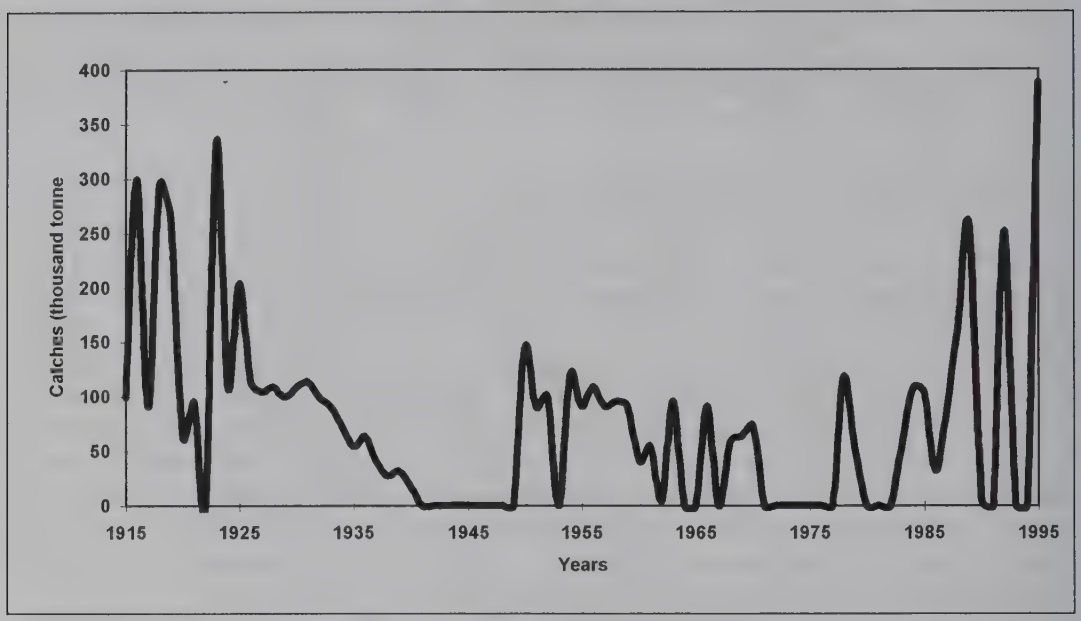


Figure B16.6

Another valuable export product, resulting from the cultivation of primarily wild stocks, is black pearl. However, they are important only to the economies of French Polynesia and the Cook Islands. Pearl farming is still the only commercially significant application of aquaculture in the South Pacific islands and the success of shrimp farming in a number of Melanesian countries continues to vary.

In general, across the Pacific islands region, little is known about the volumes being extracted (see Table B16.1). Export categorisation is often confused, coastal fishery stock assessment is virtually non-existent, and most of the information used in policy-making is anecdotal in origin.

Table B16.1. -Current annual exports of major coastal fisheries commodities from the Pacific islands region (data from SPC)

Sea cucumber	1 500 tonnes (dried, equivalent to 15 000 t live weight)
Trochus shell	2 000 tonnes of shell
Pearl shell	400 tonnes (mainly spent farmed shell)
Pearl	US $ 100 million value
Eteline snapper (mainly Tonga)	300 tonnes
Giant clam (mainly Fiji)	20 tonnes of adductor muscle
Live serranids	unknown

Some organisms (such as trochus, smaller aquarium fish and shallow-water holothurian species) are resilient enough to adapt to such pulse-fishing. However, other species (such as grouper, giant clam, green snail and pearl oyster) are often fished far beyond their capability for short-term recovery.

Most South Pacific island governments are coming to appreciate that reef fishery resources are not an inexhaustible attractant for foreign investment, and that traditional resource custodianship alone cannot cope with the conflicting values of the cash economy. Stock assessments and controls are gradually being instituted, albeit far too late in some cases. The most appropriate way of managing these export-orientated fisheries that is evolving appears to be island-wide or nation-wide moratoria interspersed by short open seasons.

Coastal small-scale fisheries for domestic consumption

Fisheries for export and for domestic consumption in the Pacific islands region do not interact as much as they perhaps do in other regions. Much of the small range of high-value products that are taken for export, such as deepwater snapper and sea-cucumbers, are not traditional local food-sources. Some of the export species that are locally used, like giant clam, have generally been scarce enough to be considered a traditional luxury, and the Pacific islands have not yet started to export their staple marine food-sources, although this could now be changing with the advent of very high-value live market possibilities for certain reef fishes.

Most Pacific islands still depend utterly on coastal marine sources for protein for human consumption. This dependency has come about both because of the bio-geographical lack of land mammals and the limited prospects for agriculture on the smaller islands. Some remote atolls have a per-capita fishery product consumption of over 250 kg annually, whilst even comparatively developed and agriculturally-oriented countries consume over 50 kg. It is estimated that about 80% of the coastal fishery production of around 100 000 tonnes annually (excluding the export commodity production described above) do not enter the cash economy.

Apart from mainland Papua New Guinea, which in many ways may be more properly considered as part of Southeast Asia, virtually all Pacific islanders live within the coastal zone. In rural areas, virtually every person fishes. Women (who do most of the shoreline fishing and reef-gleaning) are often more important than men in putting food regularly on the family table. A great variety of marine organisms are consumed. For example, over 100 species of finfish and 50 species of invertebrates are included in the fish market statistics in Fiji, and the number of species consumed in the subsistence fishery is nearly twice this. Although (or perhaps because) there is a great dependency on coastal fisheries, the marine food base of most Pacific islands appears to be currently secure. There are fears of overfishing around several national capitals. Most Pacific islands are inevitably subject to urban drift, and there have been definite changes in species and size composition of catches in areas with large human populations, but the coastal waters of most islands are not subject to heavy fishing pressure. However, as human populations increase, the degradation of reefs and a consequent reduction in carrying capacity, rather than increased fishing pressure, can be expected to have adverse effect on fisheries. Nearly all Pacific islands have the sustainable resource capacity to feed their populations, even at the present high rates of consumption. Those territories that are importers of reef food-fish, like Guam and the Northern Marianas Islands, are so largely because of the high-quality food demands of an unusually large tourism industry. The domestic coastal fisheries production in Table B16.2 is estimated from data from a wide range of sources with a wide range of reliability. Many values are based on an average of several estimates for recent years, and some subsistence estimates are based on only one survey. It would be impossible to construct a meaningful time series of data for most of them.

Table B16.2.- Domestic coastal fisheries production (data from SPC)

American Samoa	52	215	267
Cook Islands	124	858	982
Federated States of Micronesia	637	6 243	6 880
Fiji	6 653	16 600	23 253
French Polynesia	2 352	3 691	6 043
Guam	118	472	591
Hawaii	10 206	2 000	12 206
Kiribati	3 240	9 084	12 324
Marshall Islands	369	2 000	2 369
Nauru	279	98	376
New Caledonia	981	2 500	3 481
Niue	12	103	115
Northern Marianas	141	2 825	2 966
Palau	736	750	1 486
Papua New Guinea	4 966	20 588	25 554
Pitcairn	0	8	8
Solomon Islands	1 150	10 000	11 150
Tokelau	0	191	191
Tonga	1 429	933	2 362
Tuvalu	120	807	927
Vanuatu	467	2 045	2 512
Wallis & Futuna	296	621	917
Western Samoa	208	3 281	3 489
Total	34 534	85 914	120 448

NATIONAL POLICIES FOR FISHERIES CONSERVATION AND MANAGEMENT

The countries and territories of the Pacific islands region naturally have a wide range of policies on fisheries conservation and management, but some common tendencies are apparent. For example, after the United Nations Conferences on the Law of the Sea, the independent island countries pooled their effective capacity for managing tuna fisheries probably to a greater extent than any other region. The South Pacific Forum Fisheries Agency (FFA), utilising the scientific advice of the South Pacific Commission (SPC), has a major role in harmonising national decisions and in assisting its member countries in negotiations on the access of foreign vessels to its EEZ's. FFA is also involved in the administration of multilateral access treaties, the operation of registers for distant-water fishing vessels, and the evolution of management arrangements. The Pacific island nations, which generally lack any capacity for distant water fishing, have consistently taken a more conservationist than exploitative approach to the management of highly migratory species.

National policies regarding the management and conservation of coastal fisheries vary among countries and territories of the South Pacific region since, unlike the tuna fishery, an effective or formal regional level of expression is lacking. Notwithstanding, there is a great deal of commonality in Pacific islands coastal fisheries, particularly for high-value invertebrate fisheries for export. The South Pacific Regional Environment Programme is assisting countries in conservation, especially in the protection of species that have been adversely affected by

human activity beyond the scope of mere fisheries management, whilst the SPC Coastal Fisheries Programme is presently attempting to develop a mechanism for greater harmonisation of national policy regarding the management of reef and lagoon fisheries.

As with the tuna fisheries, the concept of local resource ownership is a common principle across most Pacific islands. Although there have been government attempts to suppress this tradition in the past in some countries, most now accept that recognition of, and support for, community management responsibility is one of the strategies most likely to be successful in managing coastal fisheries. Traditional concepts of resource use do not necessarily coincide exactly with western concepts of continuous sustainability, and in some communities the cash economy has severely eroded traditional authority. However, in most countries, the basic framework of fishing rights has been in place for centuries and is keeping much of the pressure off government resource managers. Although there are sustainability problems with invertebrate fisheries targeting export products, and also with subsistence fisheries in densely populated islands, Pacific island coastal fisheries are generally capable of supporting local nutritional needs, and this is generally because of the tradition of local resource ownership.

TRADITIONAL MANAGEMENT PRACTICES FOR INSHORE FISHERIES

The South Pacific islands region is a major study area for those interested in traditional management practices. In many islands, community tenure of nearshore marine areas and fisheries has been unbroken for centuries and forms varied examples of how marine resource ownership works in different situations. In other places, traditional management systems have been eroded by the States assuming rights over resource allocation. Ironically, the Kingdom of Tonga, which is the only major Pacific island group never subject to a western colonial administration, is one of the places where traditional management systems have broken down the furthest.

Currently, there is a general revival in the authority of traditional marine tenure and resource-allocation systems in the South Pacific islands region. Unfortunately, most of the intimate knowledge that Pacific islands fishing clans had developed about the behaviour and seasonality of reef fishes and invertebrates is unwritten, and much has been lost over the course of the 20th century. In addition, the pace of social change is currently so rapid that much of the justification for traditional management - the preservation of fishable resources for the next generation - is undermined by the expectation that most of the next generation will be urban wage-earners. On the other hand, the need to export marine resources to generate the cash to pay the school fees, for example, is immediate.

If effective traditional management practices are to be maintained or revived, then Pacific island governments and institutions are faced with the tasks both of supplementing the traditional knowledge lost and compensating for the erosion of traditional motivation for conservative resource management.

17. SOUTHERN OCEANS

FAO Statistical Areas 48, 58 and 88

INTRODUCTION

The Southern Ocean is bounded to the south by the Antarctic continent and to the north by the Antarctic Convergence; as such it is the only water mass to stretch completely around a continent. The Antarctic Convergence is the region where the cold Antarctic surface waters meet, and sink below, the warmer sub-Antarctic surface waters of the southern Atlantic, Indian and Pacific Oceans, and occurs between the 50th and 60th degree parallels. The environment of Antarctic fish is characterized by marked seasonality in primary and secondary production, high oxygen concentrations and low but stable temperatures. A major physiological feature of fishes of the region is adaptation against freezing. The Southern Ocean ecosystem is dominated by krill, *Euphausia superba*, whose biomass may reach 1 000 million t. Krill form dense swarms that may be several hundreds of metres in extent and contain densities of several kilos per cubic metre.

The great historical importance of the Southern Oceans was for whale fishing and, with the demise of this fisheries in the 1960s, it was anticipated that fisheries would shift to the whale's food - krill. Although commercial fisheries have been targeting this species since the late 1960s, the catch can be best described as incidental. This has not been the case for the larger demersal fish which are found in Southern Ocean waters; these stocks have been heavily fished, mainly by longline, and often in an unregulated manner as the species of the area are readily accepted on international markets. A major concern regarding the marine ecosystem of this area has been the consequences of thinning and disappearance of the ozone layer, a meteorological phenomenon which is most pronounced in polar areas. This has the effect of decreasing the amount of ultra-violet radiation which is filtered by the atmosphere, and there is evidence that this may affect plankton. Another consequence on global warming is the

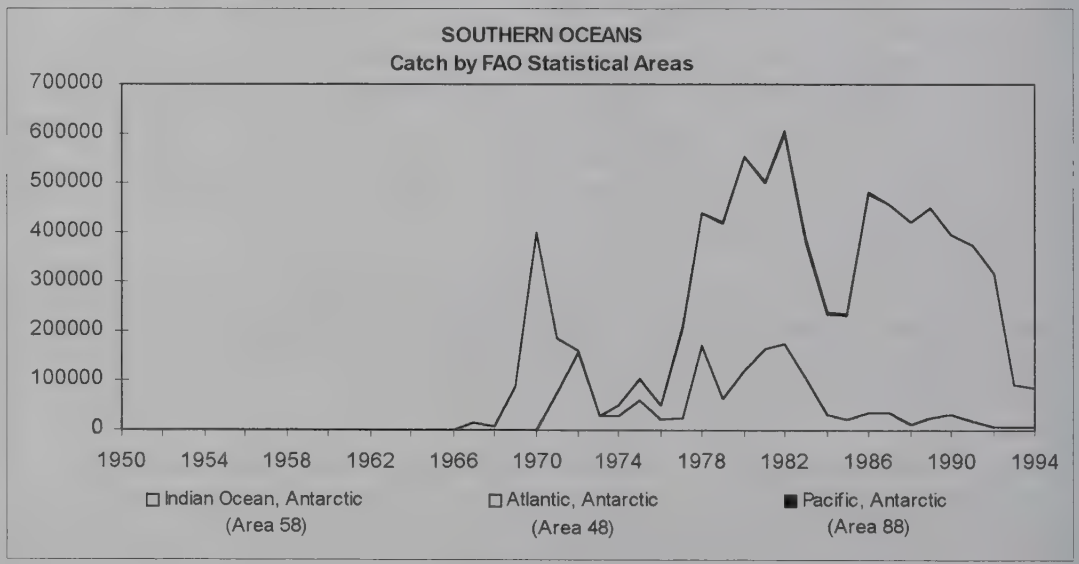


Figure B17.1

retreat of the ice front. This is resulting in new areas of the seafloor being exposed to direct sunlight and the creation of possible new fish habitats. Large sections of the ice cover have broken away and this will have uncertain affects on the ecosystems of the area.

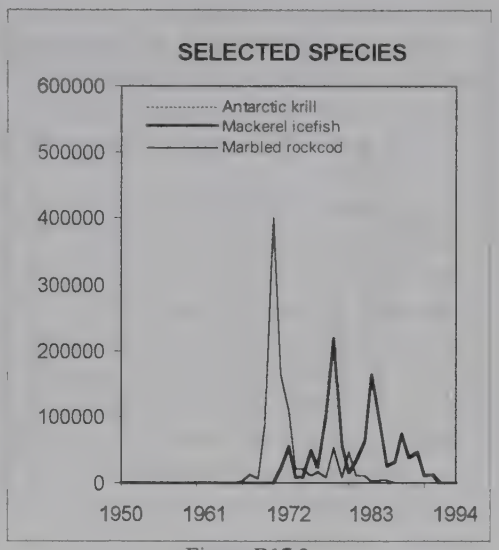


Figure B17.2

PROFILE OF CATCHES

Greatest reported landings from the Antarctic area were in 1982 (607 700 t) and coincided with the peak landings of krill (528 201 t) (Figure B17.1, Table XVI). Krill landings (Figure B17.2) started to increase rapidly from 1977 on, fell in 1983, then reached another peak in 1986 before the fishery collapsed because of lack of profitability and market demand. A fishery, important in the past, that has failed completely for market reasons was that for the myctophid, *Electrona carlsbergi*. Landings went from 78 488 t in 1991 to zero in 1993 and subsequent years.

The other three main components of the commercial catch (Patagonian toothfish, other Notothenias, and the icefish - *Champsocephalus gunnari*) have shown very different developments. Reported landings of *Notothenia* spp. peaked in 1970 at 399 800 t and subsequently collapsed; landings in the last 10 years have not exceeded 10 000 t and the fishery at present is essentially non-existent, apart from minor amounts of bycatch. The fishery for icefish started much later; first reported landings were in 1971 with peak landings in 1978 (235 296 t). Catches after that steadily declined, with a collapse of the fishery from 13 456 t in 1991 to only 66 t in 1992 and no subsequent recovery. The last important fishery, that for Patagonian toothfish, has so far been more successful. Catches peaked in 1990 at more than 9 000 t and more than 14 000 in 1992, and have remained above 5 000 t since.

RESOURCE STATUS AND MANAGEMENT

Krill

While Antarctic krill have a circumpolar distribution, being found south of the Polar Front and north of the ice edge, the assumed centres of high krill concentration are areas 48.1, 48.2 and 48.3 (i.e. the area around South Georgia and the Antarctic Peninsula). In the past there has been a seasonal shift in the fishery from South Georgia (48.3) in winter to South Orkneys (48.2) and South Shetlands (48.1) in the summer.

Krill biomass is currently estimated at 35 400 000 t in Area 48 and 3 900 000 t in Division 58.4.2. Based on an assumption that 'precautionary' harvests of krill should not exceed 11.6% of the biomass,

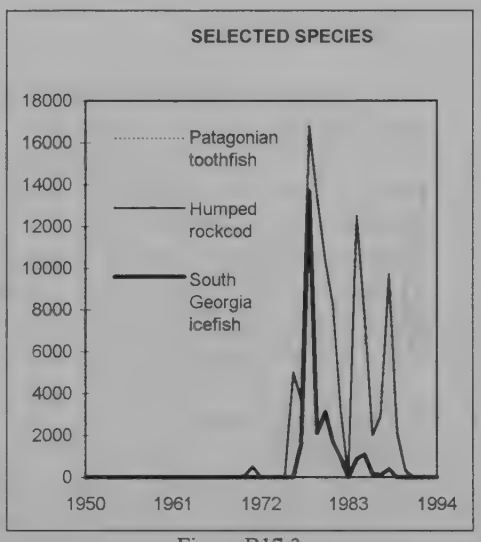


Figure B17.3

precautionary catch limits of 4 100 000 t for Area 48 while for Division 58.4.2 a precautionary catch limit of 450 000 t have been proposed. In reality, catches in 1994-95 have been far below these limits as follows: Japan 60 304 t, Poland 6 287 t and Ukraine 51 325 t, for a total of 117 916 t (i.e. an increase of 32.8% over catches in the 1993-94 season). No catches were reported by Chile and Russia, which had reported krill catches in the previous season.

Marine fishes

The Patagonian toothfish has a widespread distribution in the sub-Antarctic zone, and knowledge concerning the distribution of this species is considered to be still incomplete. Catches of 11 705 t in 1995 were reported for this species from the convention area, but CCAMLR noted that reported landings in Subarea 48.3 under-represented the true level of landings (official records were only 40% of those believed to have occurred). Official landings were up ~100% over 1994. However, a TAC of 4 000 t was set for Subarea 48.3 in 1996, compared to estimated landings of 6 171 t in 1995. Reports of illegal fishing for this species by re-flagged vessels appear to be a persistent theme from this fishery.

Landings of icefish of 3 936 t in Division 58.5.1 (Kerguelen Islands) were reported for 1995, a fishery which in the past had reached 25 852 t. This fishery is essentially closed, with no re-opening of the fishery to occur without a pre-recruit survey. There has been no resumption of the fishery for *Electrona carlsbergi* in Area 48.3 in which the last landings (46 960 t) were reported in 1992.

Marine Mammals

With their long periods to sexual maturity and low fecundity rates, it will be a long time before any recovery of the large whales is possible. Of these, the blue whale has been the most affected, followed by the humpback and sei whales. Minke whale numbers have increased, as have crabeater and fur seals. The numbers of the other major whales have decreased. A harvest of 400 minke whales per season is taken for scientific purposes in the Southern Oceans through the Japanese scientific programme, although this fishery is the subject of controversy.

Environmental issues

The Southern Oceans area, containing the marine interface with the Antarctic ice cap as well as the Polar Front, is an area sensitive to the effects of global warming. In 1995 an enormous area of the ice cap broke away turning a surface area into sea for the first time in recorded history. These ice shelves, 200-500 m thick, occupy about one third of the Antarctic coastline and have an area exceeding 10 000 km^2. Primary production beneath these shelves was considered to be impossible. Thus a reduction in this ice cover could have large ecological implications. Also of concern has been the possible effect of increased ultra-violet radiation on photosynthesis by phytoplankton, a consequence of the reduction of the ozone concentration in the upper atmosphere.

Management Issues

There is little doubt that the management of marine resources by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has resulted in conventional practices that are unusual in other international organisations responsible for management of

fisheries elsewhere, mainly because CCAMLR has a constitutional requirement to undertake an ecologically integrated approach to management of fisheries. This is manifested in a number of ways: (1) ecological relationships between harvested, dependent and related populations should be maintained and (2) any changes that are not reversible within 20-30 years should be prevented or minimised.

CCAMLR has also responded to the requirements to explicitly consider 'uncertainty' in its approach to management. A general yield model has been developed that uses a standard application of differential equations to examine different patterns of growth, mortality, spawning and fishing on estimates of yield per recruit. The model is used to evaluate the performance of stocks under different yield regimes, either as a proportion (K) of the unfished biomass or as a specified catch. A decision rule is used in setting quotas such that the probability, during the projection period, of the spawning stock biomass falling below 20% of its initial level should not exceed 10%. The value of 20% as a minimum spawning biomass is used on the basis that recruitment overfishing occurs more frequently below this level.

CCAMLR has also instituted strict rules governing the way fisheries are undertaken, to assist in data gathering for assessment purposes. For example, in the toothfish fishery in Area 48.3, fishing effort must be distributed in a manner, both in area and in time, that ensures that the catch-per-unit-effort data can be used as an effective measure for fisheries management. In the now closed fishery for icefish in the same area, fishing is not to resume without 100% vessel coverage by scientific observers, haul-by-haul reporting of catch and position data and, further, vessels must undertake a resource survey following a specified design. Similar conditions are imposed on other new fisheries in the convention area.

The other areas of concern have been minimising incidental mortality to seabirds during longlining operations. To achieve this, a wide range of operational measures must be adopted, (e.g. use of thawed bait to ensure bait sinks as quickly as possible; setting the gear at night with a minimum of vessel lighting and dumping of offal far from the gear when the gear is being set or hauled). Where by-catch must be reduced, vessels are required to move by at least 5 miles if by-catch of species under quota protection exceeds 5% of the catch and may not return before 5 days.

C. SPECIAL TOPICS

1. GLOBAL RESOURCES OF TUNA AND TUNA-LIKE SPECIES

INTRODUCTION

The sub-order Scombroidei is usually referred to as tuna and tuna-like species, composed of tunas (sometimes referred to as true tunas), billfish, swordfish and other tuna-like species.

The tunas (Thunnini) include the most economically important species referred to as principal market tuna species because of their global economic importance and their international trade for canning and sashimi (raw fish is regarded as a delicacy in Japan and recently, in some other countries). In fact, the anatomy of tunas seems to have been purpose-designed for canning and loining. The tunas are sub-classified into four genera (*Thunnus*, *Euthynnus*, *Katsuwonus* and *Auxis*) with thirteen species all together.

From genera *Thunnus*, the principal market tunas are albacore (*T. alalunga*), bigeye tuna (*T. obesus*), northern and southern bluefin tuna (*T. thynnus* and *T. maccoyii*, respectively) and yellowfin tuna (*T. albacares*). Skipjack tuna (*Katsuwonus pelamis*) is the sixth principal market tuna species. They are all oceanic, capable of long migrations or movements, and constitute one or two stocks in each ocean. The global distribution and main fishing areas of these six main species are shown on maps in figures C1.1, C1.2, C1.3, C1.4 and C1.5 respectively large, good quality, fatty individuals of bluefin sold by fishermen for sashimi can reach prices sometimes even above US$ 200 per kg if they are properly handled after catching. Bigeye can also be well priced on the sashimi markets. Yellowfin are also very popular (over US$ 2 per kg) for sashimi, but their prices are much lower. For canning, albacore get the best prices due to its white meat, followed by yellowfin and skipjack (even well below US$ 1 per kg).

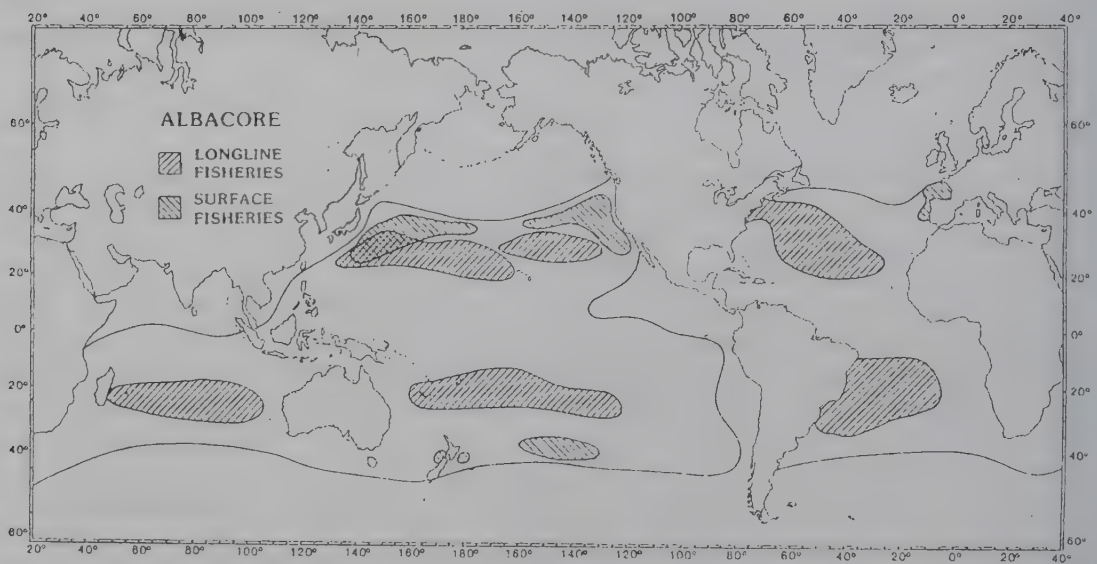


Figure C1.1

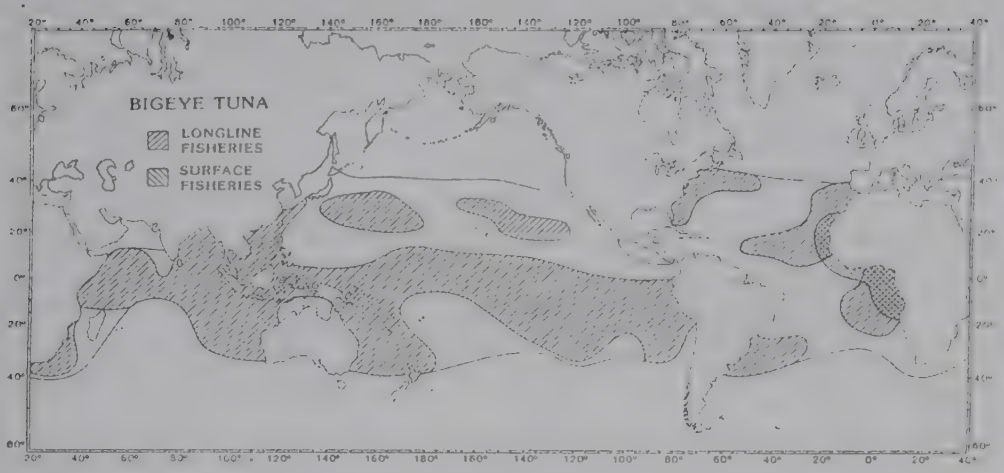


Figure C1.2

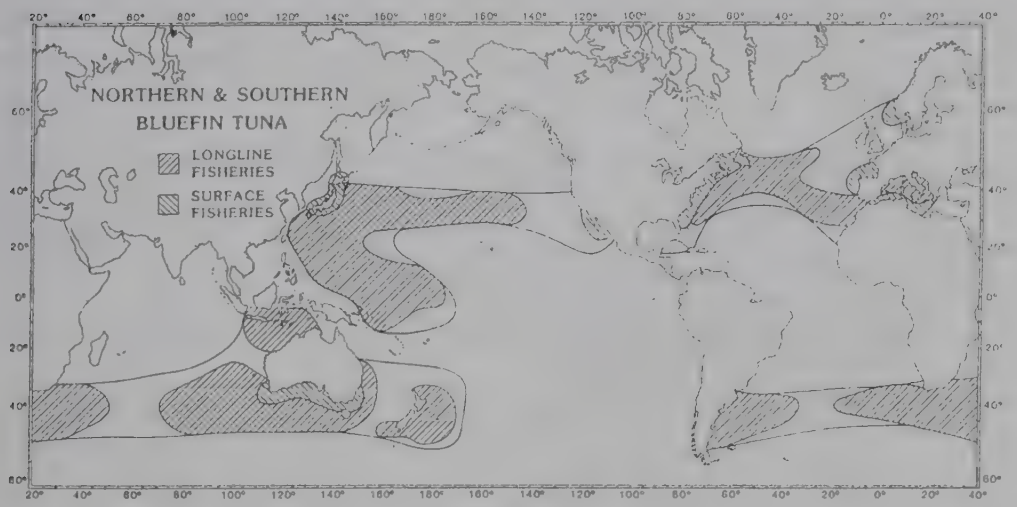


Figure C1.3

The relatively low prices of canning quality fish are compensated by very large catches, especially in the case of skipjack and yellowfin. Longtail tuna (*T. tonggol*) is another species of tuna that is becoming increasingly important for canning and is a subject of substantial international trade. The consumption of tuna and tuna-like species in forms different from canned products and sashimi is increasing.

The other tuna species are more neritic (living in water masses over the continental shelf). They include blackfin tuna (*T. atlanticus*), black skipjack (*E. lineatus*), kawakawa (*E. affinis*), little tunny (*E.alletteratus*) and bullet and frigate tuna (*A. rochei and A. thazard*, respectively). The billfishes (Istiophoridae) include marlins (*Makaira* spp.), sailfish (*Istiophorus* spp.) and spearfish (*Tetrapturus* spp.). The swordfish include only one species (*Xiphias gladius*). With the exception of two spearfishes, all billfishes and swordfish have very wide geographical distributions but not all the species necessarily occur in all oceans.

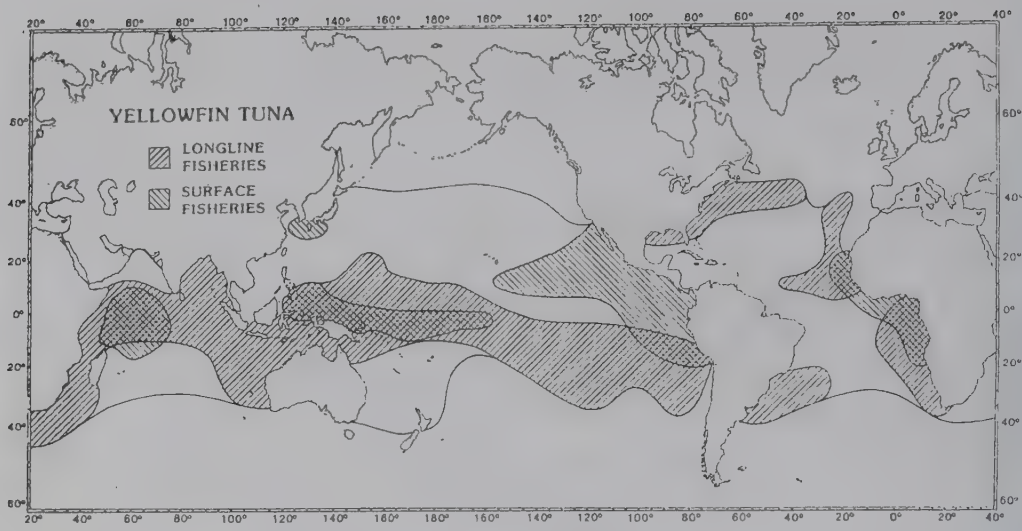


Figure C1.4

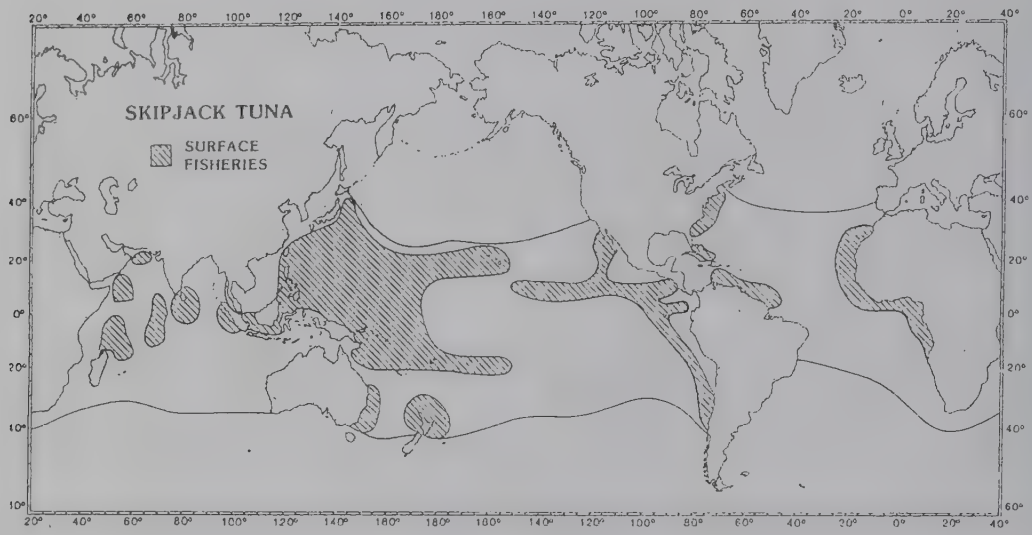


Figure C1.5

Billfishes are mostly caught by longliners as by-catches and by sport fishermen who greatly value them. Swordfish are also targeted in certain regions. Other important tuna-like species include slender tuna (*Allothunnus fallai*), butterfly kingfish (*Gasterochisma melampus*), wahoo (*Acanthocybium solandri*), bonitos (*Cybiosarda, Orcynopsis, Sarda*), Spanish and king mackerels, seerfish and sierra (*Scomberomorus* step.). They represent a significant catch potential, especially for developing countries, and are now being caught mostly by artisanal and recreational fisheries. Slender tuna and butterfly kingfish (with a circumpolar distribution in the Southern Ocean) are now mostly caught as by-catches of the Japanese longline fishery targeting southern bluefin tuna. Most of the other species mentioned in this paragraph are shared by two or more countries and their stocks are likely to straddle across the 200-mile limit.

From the tuna and tuna-like species, the principal tuna market species, billfishes, swordfish, blackfin tuna, bullet and frigate tuna, little tunny and kawakawa, are classified according to the 1982 UN Convention on the Law of the Sea as highly migratory, regardless of the fact that some of them are neritic in distribution. Black skipjack, for example, is probably more oceanic than little tunny and kawakawa.

FISHERIES

Tuna and tuna-like species are mostly caught with purse-seine, longline and pole-and-line all over the oceans (see in figures C1.1, C1.2, C1.3, C1.4 and C1.5). The purse-seine and pole-and-line methods are used to catch fish found close to the surface (e.g. skipjack and relatively small individuals of yellowfin, albacore and northern and southern bluefin tuna), whereas the longline method targets fish found at greater depths (e.g. large individuals of northern and southern bluefin tuna, bigeye tuna, yellowfin, albacore, billfish and swordfish). Billfish and swordfish are taken mostly as by-catches, though there are fisheries targeting swordfish. Most purse-seine and pole-and-line catches are canned, while longline catches, with the exception of those of albacore, are mainly sold on the sashimi market to be consumed raw, essentially in Japan. Other gear used are troll lines, handlines, driftnets, traps and harpoons. Natural or artificial fish aggregating devices (FADS) are often used in conjunction with purse-seining or hand-lining. Information on fishing vessels, flags and techniques by area are given in Table C1.1.

Table C1.1. Industrial tuna fisheries tuna wholly or partially on the high seas

Area	*Gear*	*Principal flag*	*Target species*
N.E. Pacific	troll	USA, Canada	albacore
S.E. Pacific	longline	Japan, Rep. of Korea, and Taiwan (Province of China)	bigeye, albacore and yellowfin
E.C. Pacific	purse seine	Vanuatu, Venezuela, Mexico and Panama	yellowfin and skipjack
W.C. & S. Pacific	longline	Rep. of Korea, Taiwan (Province of China) and Japan	albacore, yellowfin and bigeye
	pole and line	Japan	skipjack
	purse seine	Japan, Taiwan (Province of China), Rep. of Korea, USA, Indonesia and Philippines	skipjack and yellowfin
E. Indian	longline	Japan, Taiwan (Province of China) and Rep. of Korea	bluefin, bigeye and yellowfin
W.C. Indian	purse seine	France, Spain and Japan	skipjack and yellowfin
	longline	Taiwan (Province of China), Rep. of Korea and Japan	bigeye and yellowfin
E. Atlantic	purse seine	France and Spain	skipjack and yellowfin
	longline	Japan, Rep. of Korea and Taiwan (Province of China)	bluefin, bigeye, yellowfin and albacore
C.W. Atlantic	longline	Japan	bluefin

The tuna fisheries, especially those of distant water fishing nations (DWFN) are very dynamic. For example, in the early 1980s, many French and Spanish purse-seiners from the Atlantic shifted to the Indian Ocean, contributing to the doubling of the Indian Ocean catch in the 1980s. Some of these vessels have now moved back to the Atlantic.

Another example of the dynamic changes of which the industrial tuna fleets are capable is the cessation of operation of most US purse-seiners in the eastern Pacific because of incidental catches of dolphins. Some of these vessels from the eastern Pacific have moved into the western part of that Ocean. The Republic of Korea and Taiwan (Province of China) have also started substantial purse seine operations in the western Pacific.

More recently, small-scale longlining for high-quality fish for the sashimi market has become a frequently used method by vessels from China and Taiwan (Province of China), as well as by other developing nations. This phenomena is part of a more general trend of rapidly increasing

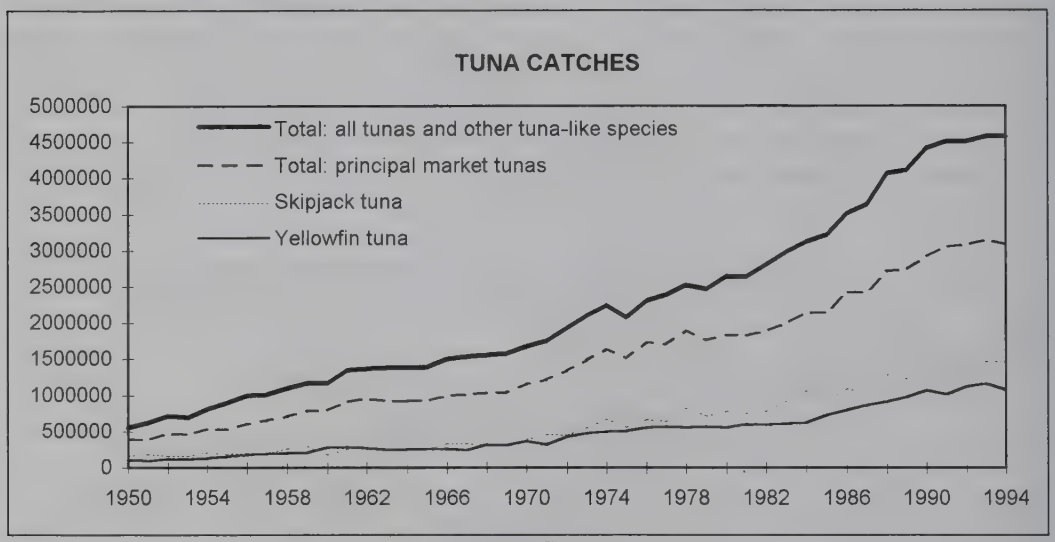


Figure C1.6

importance of developing coastal countries (including island countries of the Indian Ocean and the Pacific) in tuna fishing. This results from the purchase of purse seiners and from the intensification of artisanal fisheries. Their catches may be still under-estimated, despite the fact that the rate of non reporting of catches in developing countries is being reduced.

The use of pole-and-line and large-scale longline methods has been generally declining, while purse seining is becoming more popular. This has resulted in increased catches of skipjack and of small to medium yellowfin, while catches of large yellowfin and the other principal tuna market species have remained relatively stable.

PAST LANDINGS

The global production of the principal tuna market species has tended to continuously increase, from below 0.5 million tons in the early 1950s to 3.1 million tons in 1994, the last year for which data are currently held by FAO (see Fig. C1.6). The increase during the last ten years for which the data are available was about 44 %. Historically, the largest proportion (about 64 % now) of principal market tuna species has been taken from the Pacific, with the Atlantic

being the second largest provider of catch till the mid-1980s, when it was overtaken by the Indian Ocean, which now yields about 20% of the global tuna production. This resulted, at least partially, from the shift of some French and Spanish purse-seiners in the early 1980s from the Atlantic to the Indian Ocean.

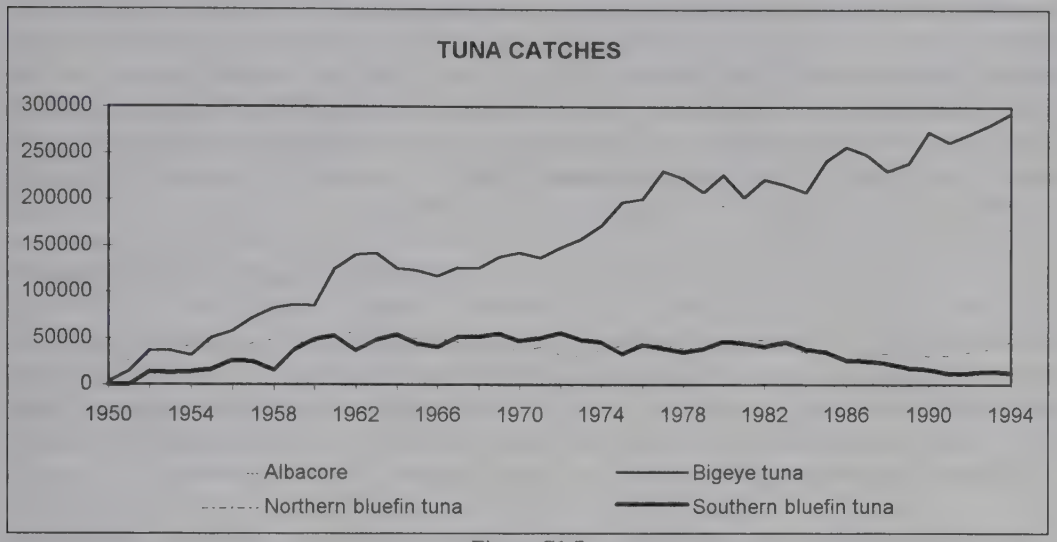


Figure C1.7

Skipjack tuna accounts for the greatest proportion of the world catch of tunas (see Fig. C1.6). In 1994, nearly 1.5 million tons of skipjack were caught, representing about half of the catch of all principal tunas, and almost all is sold for canning. In the early 1980s, skipjack catches increased sharply as a result of expansion of fishing effort into the western tropical Pacific and the western Indian Ocean. The largest increases, in terms of tonnage, have been in the Pacific, especially the western tropical Pacific, followed by the western Indian Ocean and the eastern Atlantic.

Yellowfin is commercially the second most important species of tuna and, in 1994, accounted for about 1.1 million tons or 35% of the total catch (see Fig. C1.6). Yellowfin is the premier species for canning, but more and more of the catch is being sold in fresh fish markets (also some frozen fish), particularly in the United States and Latin America. Catches in the Atlantic have shown very little change over the last two decades, whereas in the Indian Ocean they increased due to the reasons just mentioned. In the Pacific, catches of yellowfin, like skipjack, increased consistently until 1976, when they stabilized. They did not rise again until the early 1980s, when large fleets of purse-seine vessels began to fish in the western tropical Pacific.

The third most important species in terms of catch volume is bigeye tuna (see Figure C1.7), which is similar in appearance to yellowfin. However, unlike yellowfin, bigeye tunas are primarily deep-water species, spending most of their lives in cold waters below the upper mixed layer of the ocean. Again, unlike yellowfin, they are captured mainly by longline gear. Their high fat content (for insulation from the cold water) make them desired for the Japanese sashimi market. The rapid increase in catches in the mid-1970s resulted from modifications of longline gear which enabled it to be used in much deeper water than previously, leading to the substantial increases in the catches.

World production of albacore over the past three decades has been fluctuating around 200 000 t (Fig. C1.7). In the Pacific, where most albacore are taken, catches have been widely fluctuating. In the last decade, large catches of small albacore were made by drift-net fisheries on the high seas in the southwestern and northeastern Pacific. Since the termination of these fisheries, the overall albacore catch in the Pacific has declined.

Northern and southern bluefin tuna contribute relatively little in terms of volume to the total catch of principal tunas (Fig. C1.7). In the 1980s, the catch of the first species declined significantly, before increasing in the 1990s due to higher reported catches in the Mediterranean Sea. The catches of southern bluefin decreased significantly in the 1980s, stabilizing more recently.

About 71 % of the skipjack, 63 % of the yellowfin, 42 % of the bigeye and 60 % of albacore were taken in the Pacific in 1994. Of the remaining catches of skipjack in 1994, the Indian Ocean catch was 1.5 times higher than that in the Atlantic, and the yellowfin catch in the Indian Ocean in 1994 was 1.7 times higher than that in the Atlantic. The 1994 bigeye and albacore catches in the Atlantic were 1.6 and 3.8 times higher than those in the Indian Ocean. The northern bluefin tuna is taken mainly in the Atlantic but also in the Pacific. The southern bluefin tuna is taken mainly in the Indian and Pacific Oceans.

Approximately 62 % of the 1994 catch of the principal market tuna species was taken by the traditional tuna fishing countries: Japan (625 944 t), Taiwan (Province of China) (353 754 t), USA (253 408 t),), Spain (245 096 t), Republic of Korea (241 884 t) and France (193 543 t). In addition to traditional tuna fishing countries, Indonesia, the Philippines, Mexico, Maldives, Venezuela, Ecuador, Ghana, Solomon Islands, Sri Lanka, Brazil, Colombia, Panama, Iran, Oman, Pakistan, Portugal, Australia, New Zealand, China, India, Fiji, Comoros and Mauritius (ordered according to the magnitude of 1994 catches) contributed most to the 1994 catch. In fact, 1994 catches by Philippines exceeded those of France, and the 1994 Indonesian catches were not much smaller than those of France. This reflects a more general trend towards greater catch increases by non-traditional tuna fishing countries (mostly developing countries) than by traditional tuna fishing countries. The 1994 catches of each of the remaining tuna fishing countries were less than 5 000 t.

Particularly off Southeast Asia, in both the Indian and Pacific Oceans, tuna fisheries are growing, including the artisanal sector catching mostly small tunas, skipjack and yellowfin. This sector's growth was also significant in the entire Indian Ocean.

The catch of tunas and tuna-like species other than the principal tuna market species, also increased significantly from about 0.5 million tons in the early 1970s to 1.4 million tons in 1994 (Figure C1.6). Only about 11% of this catch is composed of billfishes and swordfish, taken mainly in the Pacific and Atlantic. In terms of volume of catches, according to FAO's statistics, the most important species of tuna and tuna-like species other the principal tuna market species are: Japanese Spanish mackerel (228 000 t), frigate and bullet tuna (212 000 t), kawakawa (179 000 t), narrow-barred Spanish mackerel (120 000 t), longtail tuna (101 000 t), swordfish (83 000 t), eastern Pacific bonito (57 000 t), seerfish (52 000 t), Indo-Pacific king mackerel (48 000 t) and Indo-Pacific blue marlin (28 000 t) .

RESOURCE STATUS

Information on the status of tuna and tuna-like stocks is given in Table XVII. When considering this information, uncertainties in stock assessment need to be taken into account. The data on principal market tuna species are generally much better than for other species of tuna and tuna-like species because they have been studied for many years and more research effort is devoted to them. However, even for these species, significant uncertainties exist in the basic biological knowledge. For example, recent research indicates that southern bluefin tuna, one of the best studied tunas may live much longer than expected. On the data side, officially reported catches of northern bluefin tuna, another species in a critical state, may be significantly smaller than those actually taken, according to information from a special statistical programme recently introduced by the International Commission for the Conservation of Atlantic Tunas (ICCAT).

Generally, the principal market tuna species are highly resistant to exploitation due to very high fecundity, wide geographical distributions and adaptation for opportunistic behavior. Their superbly efficient metabolic system includes a circulatory system that allows them to retain or dissipate heat as required for peak biological performance and efficiency. The dynamics of tuna populations make them highly productive. With proper management, they are capable of sustaining very high yields relative to their biomass.

However, the species most desired for the sashimi market are heavily exploited, some being overexploited or even depleted. The temperate, long-lived species of bluefin are prone to overexploitation and only recover some time after reducing fishing effort. However, concerns over heavy exploitation are raised even for bigeye, another species highly desired for sashimi, which has a shorter life span. Significant uncertainties in the status of many billfish stocks also represent a serious conservation problem.

Short-lived tropical tuna species like skipjack and yellowfin are the most resistant to exploitation and still have potential for significant increases in their catches in some areas. Swordfish in the Indian Ocean may also have such a potential. The status of other tuna and tuna-like species is highly uncertain or simply unknown. Therefore, the intensification of their exploitation raises a concern.

FISHERIES CONSERVATION AND MANAGEMENT

Some States whose vessels fish tuna and tuna-like species cooperate regarding conservation and fisheries management within the framework of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Inter-American Tropical Tuna Commission (IATTC) in the eastern Pacific, the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). CCCSBT, IATTC and ICCAT facilitate data collection, processing and stock assessment for their areas of competence, and in some cases may also cover adjacent areas if fish stocks are found to have an extended distribution. Many countries fishing tuna in the Mediterranean Sea (which is included in the area of competence of ICCAT) are not members of ICCAT but of the General Fisheries Council for the Mediterranean (GFCM). Therefore, ICCAT closely collaborates with GFCM regarding tuna and tuna-like species.

After becoming operational, IOTC will also facilitate the data collection and processing and the stock assessment for the Indian Ocean, taking over the technical responsibilities of the FAO/UNDP Indo-Pacific Tuna Programme (IPTP). With this transition underway, IPTP has already transferred the responsibility for data collection, processing and dissemination and other research for tuna and tuna-like species in the Pacific off Southeast Asia to the Southeast Asian Fishery Development Center (SEAFDEC).

The South Pacific Commission (SPC) fulfills similar technical functions, but its responsibilities do not extend to fisheries management. In the Eastern Pacific there is an established framework (i.e. IATTC) for tuna conservation and fisheries management. The South Pacific Forum Fisheries Agency (FFA) is involved in regulating access of tuna vessels of Distant-Water Fishing Nations (DWFN) in their area of competence. However, its Members are limited to South Pacific island nations, excluding DWFN's. Discussions are underway to create a tuna fishery body in the western and central Pacific. The potential problem with such a body is that the distribution of stocks of tuna and tuna-like species in the western and central Pacific is likely to extend beyond its potential area of competence. The establishment of a body covering the entire Pacific might be preferable from the technical point of view.

Generally, ocean-wide areas of competence of tuna fishery bodies seem appropriate, taking into account that tuna stocks with the exception of southern bluefin tuna are limited to one ocean. However, industrial tuna fleets are highly mobile and the principal tuna market species are intensively traded on the global scale. Also, tuna research, conservation and management problems are similar in all oceans. Therefore, there is a need for exchange of information and collaboration on the global scale regarding tuna fisheries, as well as some other species. An important example of such an collaboration is the formulation, in 1995, of the Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. The United Nations (UN) facilitated the conclusion of this Agreement, but the Food and Agriculture Organization (FAO), UN's specialized technical agency with responsibilities for various fisheries matters on the global scale, was actively involved, with technical advice, in reaching the Agreement.

After its ratification, the 1995 UN Agreement will become a new legal basis for conservation and fisheries management of tuna and tuna-like species, supplementing the 1982 UN Convention on the Law of the Sea. In 1995, the Code of Conduct of Responsible Fisheries was completed within the framework of FAO. Although not legally-binding, the Code provides a norm for all fisheries and related activities. The Agreement and the Code pose new requirements for conservation, fisheries management, technology and research for tuna and tuna-like species, which are likely to affect various sectors of the tuna industry (see below).

At present, the prime conservation problem for tuna and tuna-like species is the depletion of stocks of bluefin tuna. This concern has even been discussed outside of the framework of regional tuna institutions (i.e., within the context of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)). Generally, for many tuna fishing fleets, there is no control on their capacity or actual fishing effort, nor their catches, creating a potentially serious problem. Despite this, serious overfishing has been largely avoided due to reduction in economic incentives, the lowering of prices as markets become saturated, and still existing possibilities for expansion on some species.

The overall yield from tuna and tuna-like species depends on the combination of fishing techniques as well as the overall fishing effort because different methods have differing abilities to target various age groups. Improvements in the long-term yield might be achieved in some cases (e.g. for albacore and yellowfin in the Atlantic and after stock recovery, the northern and southern bluefin tuna) by protecting small or immature fish and targeting older age-groups more precisely. Problems occur with compliance to the present size regulations (e.g., within the framework of ICCAT, especially for northern bluefin tuna in the Mediterranean Sea). Protection of small size fish may be ineffective for stocks with high natural mortality like skipjack, or may be locally ineffective in areas of intense migration.

Bio-economic interactions among fisheries need to be scientifically addressed for the resolution of fisheries management problems. Coordinated effort in this direction is being made. For example, FAO has initiated a Japanese-funded Trust Fund project: "Cooperative Research on Interactions of Pacific Tuna Fisheries". In 1995, the project sponsored the Second FAO Expert Consultation on Interactions of Pacific Tuna Fisheries.

Dolphins caught incidentally by purse-seiners targeting yellowfin in the eastern Pacific have been another area of concern. Research, management restrictions and monitoring have resulted in significantly reduced incidental mortality of dolphins. Many canneries have stopped accepting tuna that are caught with dolphins with implications for fishing operations in the eastern Pacific. The need to protect dolphins in the eastern Pacific may also lead to smaller catches of large yellowfin as these are usually associated with dolphins, resulting in sub-optimal tuna fishing.

FUTURE CATCHES

Extrapolating the recent increases to catches of principal tuna market species, the annual catch of these species might increase slightly to over 4 million tons (i.e., by 875,000 t or 27 %) by year 2000. From the biological point of view, an annual catch of 3.9 million tons might be sustainable (coming from possible increases in catches of skipjack and yellowfin). That catch might require about 100 purse seiners (the most important fishing vessels from the catch volume point of view) in addition to the 450 large purse seiners which are currently catching about 4 500 to 5 000 t per year each. Even with recent rises in prices of canning-quality tuna, such an increase is unlikely. According to one prognosis, is it more realistic to expect an increase in the future to an annual catch of 3.5 million tons

Another factor affecting future catches will be the adoption and implementation of the provisions of:

(a) the 1995 UN Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 19982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and
(b) the Code of Conduct of Responsible Fisheries.

These are likely to affect the traditional image of unrestricted fishing on the high-seas. If properly implemented, the Agreement and the Code may reduce the rate of catch increase or even the magnitude of present actual catches in the short term. However, in the long term, they may result in larger sustainable catches due to better conservation and more rational management of tuna fisheries.

2. LANTERNFISHES: A POTENTIAL FISHERY IN THE NORTHERN ARABIAN SEA?

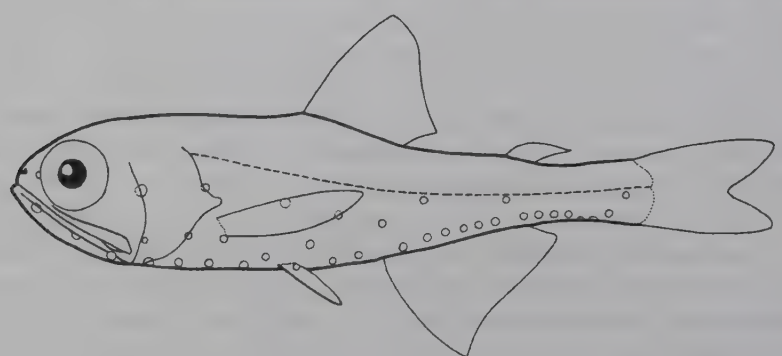
INTRODUCTION

The possibility that lanternfishes could support globally significant fisheries has been known since the 1960s. There are many species of lanternfishes in the Myctophidae family and together with Gonostomatidae species they account for around 75% of the total global catch of small mesopelagic oceanic fishes. Lanterfishes (or myctophids) typically have a maximum size of 7-8 cm (standard length, SL), with individuals in this size range weighing 2-6 g. While distribution is worldwide, production appears to be highest in tropical and sub-tropical areas. There are few examples of commercial fisheries targeting lanternfishes. A Soviet fishery for *Diaphus coeruleus* and *Gymnoscopelus nicholski* (species which were considered edible) in the Southwest Indian Ocean and Southern Atlantic began in 1977, and catches by former USSR countries reached 51 680 t in 1992, after which the fishery ceased. Despite this, the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR) still permits a TAC for this fishery of 200 000 t in its convention area. An industrial purse seine fishery for *Lampanyctodes hectoris* in South African waters closed in the mid-1980s due to processing difficulties caused by the high oil content of the fish.

In the late 1970s and early 1980s researchers investigated the feasibility of the development of a commercial fishery for mesopelagic fishes in the northern Arabian Sea. These studies indicated that such a fishery may be commercially feasible, especially for *Benthosema pterotum* in the Gulf of Oman region. After a long period of high expectations, 1996 has seen the start of a commercial fishery for these mesopelagic fishes in the Gulf of Oman.

LIFE HISTORY AND BIOLOGY

The highest density of myctophids in the region was in the Gulf of Oman, with *B. pterotum* being the only species. Other species (*Benthosema fibulatum*, *Diaphus* spp., *Myctophum spinosum* or *Symbolophorus evermanni)* were occasionally numerically more common than *B. pterotum* in the Gulf of Aden. Along the southern Omani and northeastern Somali coasts, *B. fibulatum* dominated trawl collections and acoustic surveys records. In the eastern and northeastern Arabian Sea, *Diaphus arabicus* and *D. thiollieri* were common. Along the coast of Pakistan myctophid concentrations consist almost exclusively of *B. pterotum* with densities decreasing to the west.



Benthosema pterotum

Temporal and spatial distribution

The fish ascend into shallow (<100 m) or surface waters (<5 m) at night and return to deep water (typically 250 to >1000 m) during the day (i.e. a 24 hour, or diel, migration). However, certain life history stages often migrate little, if at all, and in some populations sizable fractions of the population normally associated with vertical movement may not do so every day or at all. Echo sounder records show that many myctophid species aggregate in compact layers, especially during the daytime when they are relatively quiescent. These aggregates are the primary component of the acoustically dense "Deep Scattering Layers". Their densities, which correspond to concentrations of five-ten individuals per cubic meter and trawl catches of up to 10 to 20 t/hr have led to commercial fishery feasibility trials.

Concentrations of *B. pterotum* usually divide into two deep daytime layers (an upper 'D1' layer and a deeper 'D2' layer) and two shallower night layers (an upper 'N1' layer and deeper 'N2' layer). The D1 layer is centered at about 150 m (range 130 to 200 m) and is the most densely concentrated of the diel layers; abundances can exceed 8 individuals per m^3. The D2 layer is more diffuse and is centered at 250 m (range 150 to 350 m). A descent of individuals from D1 to D2 beginning a few hours after sunrise and a return movement to the D1 layer commencing two to three hours before sunset has been noted, although on other occasions only a single daytime layer has been observed. Daytime layers are usually deeper (250 to 350 m, occasionally 300 to 500 m) in offshore waters of the Arabian Sea. Vertical migration at night usually starts about one hour prior to sunset and is essentially complete between one-half to one hour after sunset. The N1 zone ranges from near the surface to 100 m and is centered between 20 and 50 m, whereas the more diffuse N2 zone ranges between 220 and 300 m. In addition to being the densest layer, the N1 layer, where distinct from the N2, essentially contains only *B. pterotum*. Other layers include other myctophid species, other fishes, shrimps, euphausiids and salps.

Observations based on a fifteen-month acoustic data set indicates a regular four-fold variation in stock size of *B. pterotum* in the Gulf of Oman. The variations follow the summer-winter monsoon pattern, with highest stock estimates during May and June (beginning of summer monsoon) and lowest in November (beginning of winter monsoon). This cyclic pattern could be due to variation in productivity caused by upwelling. Data from different periods between 1975 and 1984 also show a pattern of variability which is correlated with the monsoon pattern.

Life history parameters

Most of the Arabian Sea myctophid species are small, typically less than 50 mm SL at maximum size. In the Gulf of Oman, *B. pterotum* rarely exceed 40 mm and most individuals are less than 35 mm. Data suggests a life span of less than one and that two generations may be produced within a year. Age at maximum size is seven months and ten months for the Gulfs of Aden and Oman respectively. Sexual maturity in females is at relatively small sizes (~ 40 mm SL) and at an age four to five months.

Reproductive output of *B. pterotum* is low: females between 27 and 52 mm SL collected off Mozambique produced between 200 to 3 000 eggs. Lower fecundity has been reported from the Gulf of Oman (210 - 1 334 eggs in individuals 27 to 48 mm SL). Studies of the seasonality of reproduction in the Arabian Sea found actively spawning individuals during all seasons, but

there appeared to be increased spawning during monsoon transition periods (March-June and September-November).

Chemical composition

Several studies have assayed the chemical composition of myctophids and other mesopelagic fishes. These studies show that from a nutritional standpoint myctophids are high in proteins, variable but lower in lipids and uniformly low in carbohydrates. A number of studies have evaluated the lipid content of vertically migrating myctophids and found that they include both triglycerides, believed to serve primarily as an energy store, and wax esters, mainly used for buoyancy.

STOCK ASSESSMENT OF TARGET SPECIES

The stocks of myctophids have been assessed by both scientific trawl and acoustic surveys. Neither of these approaches is considered entirely accurate alone (it is suspected that the small trawls are too easily avoided, that escapement is high from the large trawls and that precision of acoustic surveys is low due to uncertainty over the actual backscattering cross-section per unit weight of fish sonified). Therefore acoustic surveys are typically combined with one of the trawl approaches.

In the late 1970s and early 1980s a number of Norwegian researchers reported on catch rates of mesopelagic fishes along the coasts of Somalia, Oman, Iran, Pakistan, and also in the Gulfs of Oman and Aden. As these concentrations consist essentially of only *B. pterotum*, it is easier to ascertain catch rates, stock sizes and life history parameters affecting stock size. The catch rates reported were highly variable among and within cruise periods and regions, even over small areas such as in the Gulf of Oman proper.

Norwegian data in the Gulf of Oman from the mid-1970s found average catch rates from krill and Harstad trawls (250 m^2 and 400 m^2 opening cross-sections respectively) to range between 0.05 and 2.5 t/hr. Larger commercial pelagic trawls (650-700 m^2) had mean catch rates of 3.8-5.0 t/hr, with occasional massive catches of 20 to 100 t/hr. More recent trawl survey data from the Gulf of Oman reflect these earlier findings for this region. The largest catches were consistently in the D1 layer (from 4.5 to 80 t/hr, average 37 t/hr) while D2 catches were below 1 t/hr and the N1 layer yielded an average of 10 t/yr. Acoustic survey data collected at the same time found only a few regions of high density concentrated in the westernmost part of the Gulf.

Total stock estimates in the Gulf of Oman range from 1.7 to 20 million tonnes. The difference in estimates may be due to the seasonal variation in abundance and/or differences in methodology. While studies that focused on the commercial aspects of mesopelagic fishes in the northern Arabian Sea-Gulf of Oman regions have discussed variations in hourly catch rate and standing stocks, few have presented estimates on potential yields. One report for the eastern Gulf of Oman estimated a potential annual yield for *B. pterotum* of 2.3 million tonnes which was believed to be a conservative figure, but this estimate does not imply 'availability' of this amount of stock to commercially viable fisheries. Given the annual variability of survey data coupled with the short lifespan of *B. pterotum* and the patchy distribution of densities of this species regionally, it is unlikely that a single MSY figure will be useful for management of the stock over an extended period.

Variability in catch data among and between cruises, regions and seasons has been observed by all researchers. In addition to natural population variability, two other sources of variation in catch rates arise from the different aims of scientific surveys and the different gear used. For instance, the mid-70s cruises mainly focused on assessing the species composition of the acoustic scattering layers and calibrating the acoustic data, while late 1970s and 1980s cruises were attempts to employ commercial-sized fishing gear and obtain high catch rates. Different gears were used for each of the different studies, leading to differences in net escapement. The smallest mesh sizes in the various commercial trawls employed was about 9 mm but significant levels of net escapement of smaller myctophids occurred in scientific trawls of 1.6 mm vs. 4 mm meshes. Fish of different lengths will have different vulnerability to gear depending on the size structure of the population and gear used.

POTENTIAL EFFECTS OF A FISHERY

No studies have examined the potential effects of a commercial myctophid fishery on other mesopelagic fish populations, and few have dealt with other organisms that ecologically interact with myctophids. Since fishing effort and ecological impacts are linked (in a complicated and unknown way) the absence of any data on future probable effort levels confounds the evaluation of potential impacts. However, a commercial fishery for *B. pterotum* focused on the high densities in the D1 layer in the Gulf of Oman will have little direct effect on other mesopelagic fishes, since the D1 layer is essentially monospecific. Extension of the range of fishery eastward along the coast of Pakistan, into the Gulf of Aden, or south into the Arabian Sea, will alter this scenario as mesopelagic diversity in general increases in all of these areas. Likewise, trawling in the deeper D2 zone or the night-time zones will capture non-target species to a highly variable degree.

The potential effects of the removal of a sizable fraction of myctophids from the Gulf of Oman by fisheries operations also raises the issue of the effect on their zooplankton prey and on their competitor species (salps, other fishes and carnivorous crustaceans). However, the important stocks of tunas, mackerels and billfishes that inhabit the northern Arabian Sea and Gulf of Oman region are unlikely to be too affected because myctophids appear to form an insignificant part of their diets. However, it is possible that in the Gulf of Oman and other northern Arabian Sea regions, where the oxygen content of the water has limited or eliminated the presence of other small fish species, *B. pterotum* may be a more significant component of the diet in at least scombrid fishes. While many cephalopods are piscivorous, especially in larger species, or at larger sizes, there are virtually no data on the nature of feeding in larger cephalopods in the available literature. At least 20 species of cephalopods have distributions that range into the northern Arabian Sea-Gulf of Oman region and, of these, at least nine species exhibit depth ranges that would bring them into contact with mesopelagic fishes.

A number of cetacean species prey on myctophids and among the non-mesopelagic animals that may be affected by a commercial fishery for myctophids, these are likely to be the most influenced. Stomachs from representatives of three cetacean families in the Pacific Ocean, the Delphinidae (five species), Phocoenidae (1 species) and Physeteridae (1 species) showed myctophid remains. The delphinids especially appear to be dependent on myctophids. Two of the delphinid genera and three species (*Delphinus delphis*, *Stenella attenuata* and *S. longirostris*) and the physeterid *Kogia simus* have been recorded from the Gulf of Oman and northwestern Arabian Sea. However, among ocean-dwelling cetaceans, the level of dependence is variable.

DISCUSSION

It is clear that *B. pterotum* should be the focus of exploratory commercial fishing and continued scientific research efforts. Other species that could be considered for study prior to commercial exploitation are *B. fibulatum* and *D. arabicus*. The zone for concentration of fishery efforts should be D1. While all reports indicate that the stocks of mesopelagic fishes in general and *B. pterotum* in particular are large and that it is unlikely that overfishing of the entire resource could occur, there are several reasons for caution in the development and management of such a fishery.

For instance, since *B. pterotum* spawns during the late afternoon-evening hours while migrating to the surface, an intensive fishing of the D1 layer during the day is going to constantly remove reproductive individuals from the population before they can spawn. Concerns over the maintenance of recruitment may have effects on strategies for sustainable exploitation. There is also large uncertainty attached to stock estimates as mentioned above. This uncertainty arises from a number of factors such as high spatial and temporal variability in catch rates, question marks over stock identity (and associated regional differences in lifespan and growth) and the strength of seasonal effects on growth and abundance. Regarding stock identity, current growth rate estimates and data on reproductive patterns suggest that separate aggregations of *B. pterotum* may exist in the Gulf of Oman, Gulf of Aden and perhaps in the northern Arabian Sea. The wide range in densities by region means only certain areas will support commercial fisheries. It is possible that locally-intensive fishing could deplete myctophids in limited areas and if these different regions are populated by different sub-populations, the spawning sub-populations could become over-fished.

It is probable that for this species, that stock estimates (and management decisions) must be done at least annually. If seasonal variability is cyclic, tied to the monsoon seasons, then semi-annual evaluations of stock are advisable. An additional reason for caution is that the potential effects of a fishery on the ecosystem are not adequately understood. Although there is agreement as to the importance of myctophids in the cycling of energy in oceanic ecosystems, there have been few studies evaluating myctophid interactions with higher trophic levels. At least among the cetaceans, correlations have been observed between loss of favoured prey items and abandonment of a region.

Using the most recent estimates for catch rates and biomass, certain simple calculations can be made. The most recent estimates of maximum average catch rates in the D1 layer is about 37 t/hr and potential annual maximum sustainable yield is 2.3 million tonnes. If one assumes that fishing is limited to the D1 layer only, beginning one hour after sunrise and ending one hour before sunset (when the fishes have settled into the D1 layer) for a 10-hour fishing day, approximately 370 t/day would be landed, over twice the vessel's processing capacity. If the average N1 layer catch is included (10 t/hr) beginning one hour after sunset and ending one hour before sunrise, daily (20 hours fishing) the catch rises to 470 t. If 470 t/day was realistic, and if maximum effort (365 fishing days) were possible, total annual tonnage landed by the one vessel would be 171 550 t, approximately 7.5% of the MSY estimate for the eastern part of the Gulf of Oman. A more realistic assessment might be based on other data in which a total of 17 trawls were fished in eight days for a total of 900 t, or roughly 112 t/day. Based on this figure, trawling every day of the year would produce about 41 000 t/vessel. A more realistic 250 fishing days would net about 28 000 t.

These assumptions are obviously extremely simplistic. Variations in catches are extreme, often few hundred kilograms to a few tonnes even in the D1 layer. Time of year is significant, and catches may fall to negligible levels over wide regions. It was found that fish densities in the D2 layer (average 3 t/hr) were too low to be commercially viable. This further reinforces the possibility that fishery operations will be conducted intensively in localized regions, particularly the western end of the Gulf of Oman.

3. GLOBAL SYNCHRONY IN FISH POPULATION VARIATIONS

As more and more experience of long-period variability in fish populations accumulates, a remarkable pattern seems to be emerging. Many of the largest fish stocks of the world seem to be growing and declining rhythmically, with a high degree of synchrony between them. The simultaneous rise and fall of sardine (pilchard) populations in widely separate areas of the Pacific Ocean was first pointed out by Kawasaki (1983) at the major FAO Expert Consultation held that year (Sharp and Csirke, eds., 1983). Since Kawasaki's paper appeared, the pattern he reported has continued to hold, including an additional episode of quite simultaneous change of trend from population growth to abrupt decline in the ensuing period (Figure C3.A).

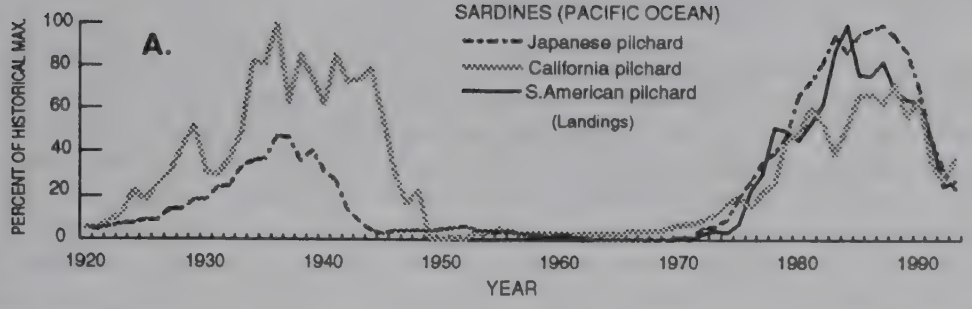
Many other similar impressive examples can be cited. For example, the Peruvian anchoveta, which grew to support the largest fishery that has ever existed, the Southern African pilchard fisheries (Figure C3.B), as well as the Japanese flying squid (Bakun, 1989), all rose and peaked between the late 1950s and early 1970s during which period the large Pacific pilchard stocks essentially vanished.

The early period from the 1970s to the mid-1980s, which saw the massive rises in population sizes of the sardine stocks in the Pacific, and the collapses of the Peruvian anchoveta in the Pacific and the Southern African pilchard in the Atlantic, was also remarkable as a period of global average temperature rise, suggesting the likelihood that climatic variability may be the driving force linking these variations (Kawasaki and Omori, 1988). However, it seems unlikely that temperature alone could be the major causal agent, since the sea temperatures on the eastern and western sides of the Pacific Ocean tend to vary out of phase rather than in phase. This has also been a period of enhanced El Niño conditions, marked by a long-period progressive collapse of the Southern Oscillation Index (Bakun, 1996), commencing with the 1972 El Niño and culminating in the major 1982-83 El Niño episode. It is well known that El Niño Southern Oscillation (ENSO) is the dominant driving force for short-period climatic variability throughout the world.

For reasons not well understood, the 1972 El Niño did not have a substantial impact in the North Pacific. Thus the period seems to have commenced a little later there, where as the 1976 El Niño had a relatively much greater effect. Accordingly, one sees the large North Pacific salmon populations rising dramatically from the mid-1970s to the mid-1980s (Figure C3.C).

While recent landings of sardines, anchovies, and salmon may constitute rough indicators of population size, this is not the case with many other populations, particularly those with regulated landings (i.e. by quota). However, where actual biomass assessments are available, as for the large populations of North Pacific groundfish, a similar pattern is often evident (Figures C3.D and E). Moreover, as soon as one looks at the decadal-scale variability in other fish populations throughout the world, there seems to emerge a remarkable degree of adherence to these general patterns (e.g. Bakun, 1996; also this volume).

Clearly, no one is yet sure that these ostensible patterns are anything more than fortuitous happenstance, nor has a comprehensive objective analysis been produced. However, there is no doubt that if there does exist a truly effective climatic linkage mechanism which acts to synchronize variability in many of the largest and most important fish populations of the world, it has very interesting and important connotations for management of the global fish supply and for understanding, and even predicting, fishery resource variability.



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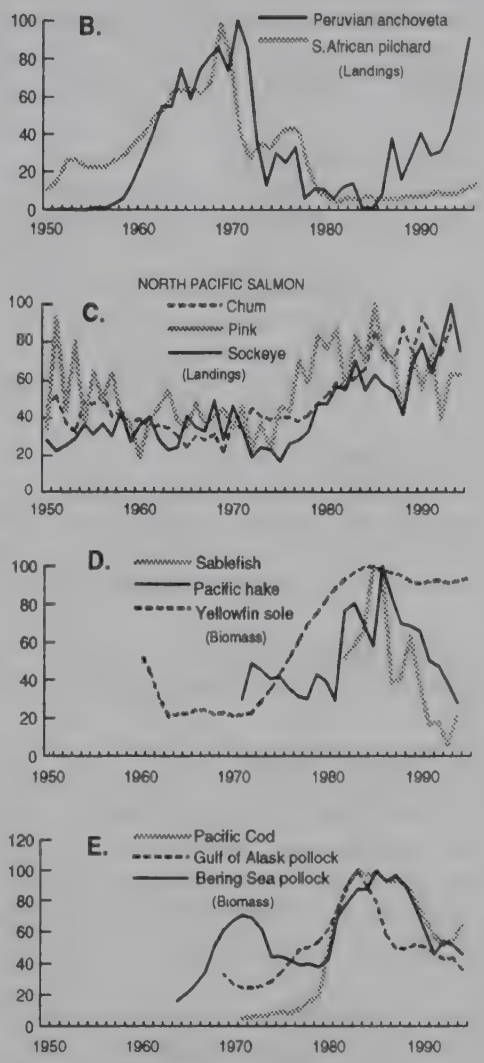

Figure C3. Long period variability in some of the world's largest fish stocks expressed as percentages of maximum recorded annual values. Data for panels A, B and C are from FAO files and from Csirke (1995), for panels D and E from Wespestad (1996) and from Anon (1996).

D. MARINE RESOURCES TABLES

This section contains Tables I to XVII referred to in the regional reviews (Section B) and the global review on tunas (Section C). Since these tables summarize information that is supplementary to that provided in previous sections, reference should be made to the pertaining regional or global reviews for further details and clarification regarding the fish resources in each FAO Statistical Area. Each table includes for each of the main stocks or group of species in the Area a short list of the main fishing countries, catch data for each year from 1988 to 1994 and ten-year averages from 1950 to 1980, as well as a brief annotation on their state of exploitation. Grand totals of marine aquaculture, total production (capture and aquaculture) and total marine capture are included at the end of each table. Brief notes describing the criteria and symbols used in the following tables are provided below.

NOTES FOR ALL TABLES

Catches and landings

All catches and landings are expressed in tons and are rounded to the nearest thousand. The main sources of the catch and landing information are:

- FAO Yearbook of Fishery Statistics (catches and landings), FAO, Rome
- FAO Fishery Data Base, FISHBASE, FAO, Rome
- CECAF Statistical Bulletins (for the Eastern Central Atlantic, Area 34)
- GFCM Statistical Bulletins (for the Mediterranean and Black Sea, Area 37)
- Various national and regional bulletins and reports (for various Areas)

Stock or species groups

Includes selected exploited or exploitable stocks or groups of species. Criteria for selection includes high volume of current or historical catches, high commercial value and high potential for development. These have been grouped by FAO ISSCAAP (International Standard Statistical Classification of Aquatic Animals and Plants) species group.

Main fishing countries

Countries are listed in ranking order by catch size in the latest recorded year.

State of exploitation

The state of exploitation as shown by the abbreviations below represents our best estimate of the state of the stock, its potential for increased production or requirement for stock recovery. The estimates are based on the best information available, which may include the results of peer-reviewed published reports as well as the analysis of qualitative data and information whose reliability may vary from one region to another as well as between stocks or groups of the same or of different species within the same area.

? (or blank) = Not known or uncertain. Not much information is available to make a judgment;

U = Underexploited, undeveloped or new fishery. Believed to have a significant potential for expansion in total production;

M = Moderately exploited, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production;

F = Fully exploited. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion; (*)

O = Overexploited. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse;

D = Depleted. Catches are well below historical levels, irrespective of the amount of fishing effort exerted;

R = Recovering. Catches are again increasing after a collapse from a previous high.

(*) *Category* F *above remains equivalent in usage to that in previous editions of this review, even though the word 'heavily' used in earlier editions has been eliminated from the former 'F - fully heavily exploited' category to avoid the confusion which arose with the category 'O = Overexploited'.*

CALL TO READERS.- Readers who are willing to contribute to improving the accuracy of future revisions of this document are kindly requested to address their contributions under the heading "C920 Resources Review" to: Chief, Marine Resources Service, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

Table I . - State of exploitation, total production and nominal catches by selected species groups fished in the Northwest Atlantic (FAO Statistical Area 21), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Amer. plaice(=Long rough dab)	USA, Canada, Spain	31	75	97	80	73	71	43	51	40	18	9	F
Yellowtail flounder	USA, Canada, Spain	9	42	50	30	16	16	27	21	16	12	6	F
Winter flounder	USA, Canada	10	15	15	16	12	10	12	13	10	8	7	F
Flatfishes nei	Canada, Japan, USA	2	9	4	6	7	4	3	0	0	11	7	F
Greenland halibut	Spain, Greenland, Canada	1	17	47	38	33	33	59	69	96	81	79	F
Witch flounder	USA, Canada, Portugal	5	28	38	19	22	15	14	15	12	10	5	F
Summer flounder	USA	7	5	7	11	14	8	4	6	8	6	5	F
Other Flounders,halibuts,soles		5	4	3	6	6	5	5	7	4	4	2	F
31-Flounders,halibuts,soles,..		69	194	261	206	183	163	168	182	185	150	119	F
Atlantic cod	Canada, USA, Spain	857	1 432	754	644	626	639	558	423	246	114	48	D
Haddock	Canada, USA, Cuba	144	148	39	54	35	30	26	25	25	14	7	D
Silver hake	USA, Cuba, Canada	48	180	203	83	91	106	91	83	56	46	24	U
White hake	Canada, USA, Cuba	4	7	18	24	18	19	20	71	47	18	19	F
Saithe(=Pollock)	Canada, USA, Cuba	49	37	38	61	61	58	51	53	45	28	19	F
Tusk(=Cusk)	Canada, USA	2	5	6	6	4	4	5	6	7	4	3	F
Other Cods, hakes, haddocks,..		14	47	66	12	11	8	7	9	12	10	8	F
32-Cods, hakes, haddocks,...		1 118	1 857	1 126	884	846	865	757	670	437	234	130	R
Atlantic redfishes	Canada, Portugal, Russian Fed.	175	227	216	143	148	164	183	165	156	135	66	F
American angler	USA, Canada, Cuba	0	2	10	6	10	13	13	14	18	20	21	F
Other Redfishes,basses,congers		42	54	58	36	28	20	21	23	20	21	19	?
33-Redfishes,basses,congers,..		217	282	284	185	186	198	217	202	194	177	105	?
Capelin	Canada, Greenland, St Pier Miqu	15	6	174	64	110	118	184	51	31	48	2	F
Other Jacks, mullets, sauries,		5	7	14	11	9	7	8	7	8	9	7	?
34-Jacks, mullets, sauries,...		20	13	187	75	118	125	192	58	38	57	9	?
												9	
Atlantic herring	Canada, USA, Cuba	170	451	467	229	284	275	314	277	270	259	243	U-F-R
Atlantic menhaden	USA	428	268	270	305	327	326	394	346	313	327	249	F
Other Herrings,sardines,anchov		0	0	0	0	0	0	0	0	0	0	0	?
35-Herrings,sardines,anchovies		598	719	737	534	611	601	708	624	583	586	493	
Atlantic mackerel	Canada, USA, Cuba	15	33	244	49	79	73	65	62	38	32	28	U
37-Mack.,snoeks,cutlassfishes		15	33	244	49	79	73	65	62	38	32	28	U
American lobster	Canada, USA	34	33	32	51	62	67	74	76	66	66	70	F
Other Lobsters,spinyrock lobst		0	0	0	0	0	0	0	0	0	0	0	
43-Lobsters,spinyrock lobsters		34	33	32	51	62	67	74	76	66	66	70	F

Table I Continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Pink(=Pandalid)shrimps	Canada, USA, Lithuania	0	3	11	14	19	20	23	23	23	23	27	F
Other Shrimps, prawns, etc.		0	4	27	62	87	91	92	100	104	118	121	
45-Shrimps, prawns, etc.		1	7	38	76	106	111	115	123	127	141	148	F
American sea scallop	Canada, USA, St Pier Miqu	83	120	122	155	190	205	217	209	196	147	150	F
Iceland scallop	St Pier Miqu	0	0	0	0	0	0	0	0	0	0	0	
Bay scallop		5	5	6	3	2	1	2	2	1	2	0	
Other Scallops, pectens, etc.		0	0	0	0	0	0	0	0	0	0	0	
55-Scallops, pectens, etc.		88	125	127	158	192	206	219	211	197	149	150	F
Surf clam	USA, Canada	44	124	129	150	159	173	183	163	187	184	170	M
Northern quahog(=Hard clam)	USA, Canada	52	48	45	34	29	18	18	28	27	26	12	M
Ocean quahog	USA, Canada	1	1	34	159	172	192	177	186	193	198	178	M
Soft shell(=Soft clam)	Canada, USA	17	20	24	20	18	17	23	17	17	24	26	M
Other Clams, cockles, arkshell		0	0	0	2	0	9	11	6	2	3	3	M
56-Clams, cockles, arkshells..		114	193	232	365	378	409	412	400	426	434	389	M
Selected groups		2 273	3 456	3 267	2 583	2 760	2 818	2 928	2 608	2 292	2 025	1 641	
Other groups		364	303	429	312	263	269	300	320	285	318	305	
Total aquaculture		0	0	0	7	14	20	23	29	35	39	43	
Total productions		2 637	3 759	3 696	2 903	3 038	3 106	3 250	2 957	2 612	2 382	1 989	
Total marine capture		2 637	3 759	3 696	2 895	3 023	3 087	3 228	2 928	2 577	2 343	1 946	

Table II . - State of exploitation, total production and nominal catches by selected species groups fished in the Northeast Atlantic (FAO Statistical Area 27), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Atlantic salmon	Norway, UK Scotland, Faeroe Is	7	9	10	12	6	12	8	6	6	6	4	F-D
Other Salmons, trouts, smelts,		10	14	13	11	7	9	9	9	9	7	6	
23-Salmons, trouts, smelts,...		17	23	22	23	13	22	16	16	16	13	11	
European plaice	Netherlands, Denmark, UK Engld Wal	107	161	176	169	192	192	200	184	165	158	154	O
Other Flounders,halibuts,soles		96	145	170	182	198	208	192	206	179	193	199	F
31-Flounders,halibuts,soles,..		203	307	346	351	390	400	392	390	344	351	353	
Atlantic cod	Norway, Russian Fed., Iceland	1 675	1 611	1 772	1 424	1 330	1 136	936	921	931	1 025	1 191	F-D
Haddock	UK Scotland, Norway, Iceland	289	464	493	316	303	237	177	165	181	236	303	F
Saithe(=Pollock)	Norway, Iceland, Faeroe Is	210	323	592	420	390	374	367	386	355	380	350	M-D
Whiting	UK Scotland, France, Ireland	118	191	214	147	119	89	86	83	87	90	90	F
Blue whiting(=Poutassou)	Norway, Russian Fed., Spain	13	18	223	713	661	653	575	433	465	538	487	M-F
Norway pout	Denmark, Norway, Faeroe Is	2	155	532	409	277	352	296	303	453	324	291	M-F
Polar cod	Russian Fed., Germany	1	14	105	15	0	0	0	0	21	51	6	?
Other Cods, hakes, haddocks,..		200	252	237	248	240	238	231	234	246	237	216	
32-Cods, hakes, haddocks,...		2 507	3 028	4 169	3 691	3 319	3 079	2 668	2 526	2 739	2 880	2 935	
Atlantic redfishes	Iceland, Russian Fed., Germany	222	173	234	258	224	175	189	198	179	226	275	O
Sandeels(=Sandlances)	Denmark, Norway, UK Scotland	45	152	498	810	1 042	1 134	754	1 021	1 066	745	1 037	F
Other Redfishes,basses,congers		91	122	187	194	247	240	214	203	205	188	204	
33-Redfishes,basses,congers,..		358	447	918	1 262	1 513	1 550	1 157	1 422	1 450	1 159	1 516	
Atlantic horse mackerel	Netherlands, Norway, Ireland	93	120	257	229	357	385	435	402	456	535	464	M
Capelin	Iceland, Norway, Faeroe Is	44	314	2 294	1 838	1 031	777	796	1 206	2 083	1 693	882	F-D
Other Jacks, mullets, sauries,		19	10	28	19	20	22	22	21	23	25	24	
34-Jacks, mullets, sauries,...		156	445	2 580	2 086	1 408	1 185	1 252	1 629	2 562	2 253	1 370	
Atlantic herring	Norway, Denmark, Sweden	2 478	2 738	1 078	1 079	1 401	1 360	1 222	1 122	1 266	1 372	1 643	F-D
European sprat	Denmark, Sweden, Poland	67	151	581	321	255	208	191	254	269	367	562	M
European pilchard(=Sardine)	Portugal, Spain, Denmark	179	223	165	205	175	172	184	180	216	246	244	O
Other Herrings,sardines,anchov		55	91	41	17	18	14	22	17	30	33	35	
35-Herrings,sardines,anchovies		2 779	3 203	1 865	1 622	1 850	1 755	1 618	1 573	1 781	2 017	2 484	
Atlantic mackerel	Norway, UK Scotland, Ireland	100	415	603	577	622	512	584	619	737	800	821	O
Other Mack.,snoeks,cutlassfish		18	37	20	11	12	12	15	18	21	20	13	
37-Mack.,snoeks,cutlassfishes		118	452	623	588	634	525	599	637	758	820	834	

Table II continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Northern prawn		8	18	29	117	105	112	133	134	136	130	122	F
Other Shrimps, prawns, etc.	Iceland, Norway, Russian Fed.	63	60	44	27	24	29	18	27	29	30	35	
45-Shrimps, prawns, etc.		71	78	73	143	129	141	151	161	164	160	157	
Pacific cupped oyster		27	55	69	38	0	0	0	0	0	0	0	F
Other Oysters	France, Ireland, Channel Is	7	22	16	3	1	3	0	1	2	1	1	
53-Oysters		34	77	85	41	1	3	0	1	2	1	1	
Blue mussel		97	207	311	244	77	87	106	135	143	140	106	F
Other Mussels	Spain, Netherlands, Denmark	0	0	0	0	0	1	0	3	4	7	11	
54-Mussels		97	207	311	244	77	87	106	138	147	147	117	
Selected groups		6 340	8 265	10 993	10 052	9 336	8 746	7 960	8 494	9 962	9 801	9 778	
Other groups		501	582	561	537	575	506	502	467	518	472	460	
Total aquaculture		0	0	0	396	704	694	740	741	675	694	818	
Total productions		6 842	8 848	11 554	10 984	10 615	9 947	9 202	9 703	11 155	10 968	11 055	
Total marine capture		6 842	8 848	11 554	10 588	9 911	9 252	8 462	8 961	10 480	10 273	10 237	

Table III . - State of exploitation, total production and nominal catches by selected species groups fished in the Western Central Atlantic (FAO Statistical Area 31), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Sciaenids		21	20	38	30	28	29	28	29	28	34	36	F/O?
Groupers		9	18	23	26	28	28	31	28	23	24	29	F/O?
Snapper		10	17	20	23	23	23	36	29	27	30	40	F?
Grunts		4	13	26	8	7	8	8	9	9	8	9	F?
Other Redfishes,basses,congers		12	31	33	37	29	34	35	35	37	43	48	
33-Redfishes,basses,congers,..		57	99	140	125	114	121	138	130	124	139	162	
Flyingfishes nei	Barbados, Grenada	2	2	2	3	6	1	2	1	2	2	2	M/F?
Halfbeaks nei	Grenada	0	0	0	0	0	0	0	0	0	0	0	?
Mullets nei	USA, Mexico, Dominican Rp	18	22	19	18	18	17	16	16	14	20	21	?
Flathead grey mullet	Venezuela, Mexico	3	4	5	9	10	13	16	15	15	15	17	?
Carangidae		7	10	12	14	15	16	19	15	17	19	19	M/F?
Other Jacks, mullets, sauries,		6	6	8	10	12	12	13	14	15	15	15	
34-Jacks, mullets, sauries,...		37	45	46	54	61	59	65	62	63	72	73	
Atlantic thread herring	USA, Cuba, Venezuela	2	6	9	5	4	7	8	7	6	7	4	M?
Round sardinella	Venezuela, Mexico, USA	19	38	42	61	62	72	59	76	76	88	117	M
Atlantic menhaden	USA	25	41	65	59	34	31	34	51	27	21	37	F
Gulf menhaden	USA	290	470	603	786	639	583	520	551	433	552	767	F
Other Herrings,sardines,anchov		2	7	8	4	2	2	2	2	2	2	2	M
35-Herrings,sardines,anchovies		337	562	729	915	740	696	622	687	544	668	928	
Skipjack tuna	Venezuela, Cuba, Dominican Rp	1	1	3	11	6	5	4	8	10	10	8	F
Yellowfin tuna	Venezuela, Other Asia, USA	1	7	9	21	22	25	19	29	27	28	28	F
Atlantic Spanish mackerel	Mexico, Venezuela, USA	6	10	14	15	14	17	17	20	17	20	19	F
King mackerel	Mexico, Venezuela, USA	5	6	6	6	6	5	5	6	7	10	9	M/F
Other Tunas,bonitos,billfishes		3	15	22	25	19	25	20	22	25	32	32	
36-Tunas,bonitos,billfishes,..		16	39	55	78	67	77	66	85	86	100	96	
38-Sharks, rays, chimaeras,...		3	7	10	25	31	33	30	27	30	27	34	U-O?
39-Misc. marine fishes		33	96	144	252	250	253	298	349	325	323	335	
42-Sea-spiders, crabs, etc.		22	35	38	52	65	55	49	55	61	60	79	
Caribbean spiny lobster	Cuba, Bahamas, USA	6	14	21	26	25	27	24	30	28	27	30	F?
43-Lobsters,spinyrock lobsters		6	14	21	26	25	27	24	30	28	27	30	

Table III continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Penaeus shrimps nei	Mexico, Venezuela, Colombia	5	30	54	48	46	47	49	58	51	64	61	
Northern brown shrimp	USA	58	54	59	67	63	72	79	68	54	53	52	
Northern pink shrimp	USA, Cuba	11	11	19	16	12	11	8	8	8	10	8	
Atlantic seabob	Guyana, USA	0	0	2	6	6	6	5	7	9	11	11	
Inshore shrimps nei	Haiti	0	0	0	0	0	0	0	0	0	0	0	
Pink(=Pandalid)shrimps		0	0	0	0	0	0	0	0	1	0	0	
Redspotted shrimp		0	0	0	0	0	0	0	0	0	0	0	
Northern white shrimp	USA	32	31	33	38	36	32	34	41	40	32	37	
Royal red shrimp	USA	0	0	0	0	0	0	0	0	0	0	0	
Rock shrimp	USA	0	0	1	2	2	4	4	2	4	3	4	
Other Shrimps, prawns, etc.		0	0	0	0	0	0	0	0	2	0	0	
45-Shrimps, prawns, etc.		106	126	168	176	165	172	180	185	168	173	173	F
Stromboid conchs	Mexico, USA, Turks Caicos	0	1	3	6	6	6	6	6	7	8	7	F/O
Other Abalones,winkles,conchs,		0	0	0	0	0	0	0	0	0	0	0	
52-Abalones,winkles,conchs,...		0	1	3	6	6	7	6	6	7	8	7	
American cupped oyster	USA, Mexico	80	133	164	110	24	20	40	24	40	62	59	F
Other Oysters		0	3	3	2	2	2	6	2	2	3	4	
53-Oysters		81	135	167	113	26	22	46	26	42	65	64	
Calico scallop	USA	0	2	12	117	122	67	11	0	0	0	74	F
Other Scallops, pectens, etc.		1	2	1	3	4	2	1	2	2	2	1	
55-Scallops, pectens, etc.		1	3	13	119	126	69	12	2	2	2	75	
Selected groups		698	1 162	1 533	1 939	1 677	1 590	1 536	1 644	1 479	1 664	2 056	
Other groups		11	19	34	55	54	74	77	64	63	133	90	
Total aquaculture		0	0	0	82	137	136	88	113	126	110	100	
Total productions		709	1 181	1 567	2 076	1 868	1 799	1 701	1 822	1 668	1 908	2 245	
Total marine capture		709	1 181	1 567	1 994	1 731	1 664	1 613	1 709	1 542	1 797	2 145	

Table IV . - State of exploitation, total production and nominal catches by selected species groups fished in the Eastern Central Atlantic (FAO Statistical Area 34), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	state of exploitation
Tonguefishes nei	Korea Rep, Cameroon, Nigeria	2	7	15	11	7	11	8	9	6	3	4	?
Common sole	Italy, Morocco, Spain	0	0	3	6	4	5	5	10	13	11	11	?
Flatfishes nei	Senegal, Morocco, Italy	0	2	7	10	11	10	11	16	15	13	14	?
Other Flounders,halibuts,soles		0	0	0	2	3	3	3	3	5	6	9	-
31-Flounders,halibuts,soles,..		3	9	25	29	25	28	26	37	39	34	38	-
Senegalese hake	Spain, Ukraine, Latvia	0	2	58	19	16	20	16	15	15	15	16	F-O
European hake	Spain, Morocco, Portugal	2	5	6	10	11	12	11	11	13	12	13	M-F
Other Cods, hakes, haddocks,..		0	3	6	5	3	4	5	3	3	3	3	-
32-Cods, hakes, haddocks,...		2	10	70	34	31	35	32	29	30	30	32	-
Croakers, drums nei	Korea Rep, China, Cameroon	2	7	16	9	9	7	13	6	12	12	18	F-O
Bigeye grunt	Ghana, Côte dIvoire, Senegal	3	11	24	27	22	18	38	26	21	24	26	F-O
Bobo croaker	Sierra Leone, Cameroon, Gabon	0	1	3	4	4	2	3	6	10	5	6	F-O
Common dentex	Italy, Greece, Latvia	0	2	1	2	2	2	2	3	5	4	4	F-O
Other Redfishes,basses,congers		39	146	263	260	174	192	182	186	194	169	164	-
33-Redfishes,basses,congers,..		44	167	306	302	211	222	238	227	241	215	218	-
Barracudas	Nigeria, Ghana, Senegal	3	8	21	11	8	7	10	8	9	10	9	?
Threadfins, tasselfishes nei	Ghana, Nigeria, China	3	9	19	18	5	18	8	5	4	5	8	?
Jack and horse mackerels nei	Ukraine, Russian Fed., Latvia	1	81	410	339	332	281	260	260	229	214	173	M-F
Mullets nei	Senegal, Nigeria, GuineaBissau	1	4	13	14	17	16	16	18	18	14	15	?
False scad	Ghana	0	0	1	11	12	6	18	15	15	3	4	?
Atlantic horse mackerel	Portugal	1	1	1	1	1	0	0	1	1	0	0	?
Other Jacks, mullets, sauries,		6	18	75	57	67	44	63	57	69	70	58	-
34-Jacks, mullets, sauries,...		15	121	541	452	441	373	375	363	345	317	268	-
European anchovy	Ghana, Morocco, Togo	4	4	47	113	223	234	347	207	112	103	76	?
Round sardinella	Ghana, Russian Fed., Côte dIvoire	11	24	60	161	272	279	328	362	292	182	117	M-F
Madeiran sardinella	Ghana, Côte dIvoire, Benin	1	1	2	18	23	26	31	20	22	21	19	?
European pilchard(=Sardine)	Morocco, Spain, Russian Fed.	97	188	569	622	910	1 113	1 118	1 073	724	631	702	M
Bonga shad	Nigeria, Sierra Leone, Gambia	23	41	62	107	116	132	99	101	124	110	114	?
Other Herrings,sardines,anchov		49	89	351	217	199	211	228	307	320	297	319	-
35-Herrings,sardines,anchovies		185	347	1 091	1 238	1 741	1 996	2 151	2 070	1 593	1 344	1 346	-

Table IV continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Bigeye tuna	Spain, Japan, France	3	10	36	36	31	37	34	42	43	52	58	O
Atlantic bonito	Morocco, Togo, Senegal	2	1	2	5	9	8	2	2	1	1	1	?
Frigate and bullet tunas	Spain, Other nei, Russian Fed.	0	3	6	12	4	2	3	6	1	1	2	?
Little tunny(=Atl.black skipj)	Senegal, Ghana, Côte dIvoire	0	0	5	14	15	21	21	13	14	3	3	?
Skipjack tuna	Spain, France, Ghana	0	7	71	92	101	82	108	164	115	141	135	M
Swordfish	Japan, Nigeria, Lithuania	0	1	2	3	3	4	4	2	2	3	5	?
Yellowfin tuna	Spain, France, Other nei	1	35	89	112	94	117	142	120	111	104	108	F
Tuna-like fishes nei	Sierra Leone, Senegal, Eq Guinea	0	3	3	4	15	14	15	1	2	2	2	?
Other Tunas,bonitos,billfishes		4	11	17	12	10	10	9	9	8	9	9	-
36-Tunas,bonitos,billfishes,..		11	70	230	289	283	295	339	359	298	317	323	-
Largehead hairtail	Russian Fed., Morocco, Ghana	0	5	27	58	69	68	81	99	49	23	25	?
Chub mackerel	Morocco, Russian Fed., Ukraine	3	67	168	197	326	314	173	141	80	55	104	M
Other Mack.,snoeks,cutlassfish		0	1	2	4	5	7	8	10	16	15	19	-
37-Mack.,snoeks,cutlassfishes		3	73	197	259	400	388	262	249	145	94	147	-
38-Sharks, rays, chimaeras,...		4	13	35	28	27	24	26	23	27	26	29	-
39-Misc. marine fishes		84	208	325	323	303	311	374	242	265	235	239	-
Palinurid spiny lobsters nei	Nigeria, Portugal, Senegal	1	2	1	2	4	4	4	2	2	1	2	F-O
Tropical spiny lobsters nei	Ghana, Sierra Leone, Cape Verde	0	0	0	0	0	0	0	0	0	0	1	O
Norway lobster	Greece, Morocco	0	0	0	0	0	0	0	0	0	0	0	O-?
European lobster	Greece, Morocco	0	0	0	0	0	0	0	0	0	0	0	?
Other Lobsters,spinyrock lobst		0	0	0	0	0	0	0	0	0	0	0	-
43-Lobsters,spinyrock lobsters		1	2	2	2	4	4	4	3	2	2	3	-
Natantian decapods nei	Morocco, Nigeria, Italy	1	2	5	8	12	16	15	17	16	17	19	?
Penaeus shrimps nei	Cameroon, Côte dIvoire, Honduras	0	0	3	2	2	3	3	2	1	3	1	M-F
Deepwater rose shrimp	Spain, Mauritania, Portugal	0	0	8	9	5	12	8	8	5	5	6	F-O
Southern pink shrimp	Nigeria, Senegal, Spain	1	2	6	9	7	11	10	12	17	19	14	F-O
Other Shrimps, prawns, etc		0	0	1	2	1	1	1	1	1	1	1	-
45-Shrimps, prawns, etc.		2	5	24	30	27	42	37	40	41	45	41	-
Cuttlefishes, bobtail squids	Morocco, Senegal, Mauritania	2	19	36	45	40	48	45	51	33	35	40	F-O
Octopuses	Morocco, Mauritania, Senegal	0	0	12	66	87	95	93	114	105	119	96	F-O
Common squids	Spain, Italy, Greece	0	4	13	6	4	6	6	6	6	6	6	F-O
Squids nei	Morocco, Mauritania, Spain	0	5	19	11	9	9	10	15	15	24	17	F-O
Common octopus	Spain, Italy	20	45	86	45	24	27	27	43	36	37	39	F-O
Other Squid,cuttlefish,octopus		0	1	2	6	8	8	9	7	9	2	2	-
57-Squid,cuttlefish,octopuses		22	73	168	179	173	193	190	237	203	224	200	-

Table IV continued

Stock or species group	1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Selected groups	374	1 097	3 013	3 165	3 666	3 911	4 053	3 880	3 230	2 883	2 885	-
Other groups	1	9	34	29	36	27	24	24	20	23	18	-
Total aquaculture	0	0	0	0	0	0	0	2	1	1	1	-
Total productions	375	1 106	3 047	3 194	3 702	3 938	4 077	3 906	3 251	2 907	2 904	-
Total marine capture	375	1 106	3 047	3 194	3 702	3 938	4 077	3 904	3 250	2 906	2 903	-

Table V . - State of exploitation, total production and nominal catches by selected species groups fished in the Mediterranean & Black Sea (FAO Statistical Area 37), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Pontic shad	Ukraine, Bulgaria, Russian Fed.	2	2	1	1	0	0	0	0	0	0	0	D
Azov sea sprat	Ukraine, Russian Fed., Romania	51	41	75	85	32	38	3	24	5	2	5	D
Other Shads, etc.		0	0	1	1	2	2	2	4	3	6	5	D
24-Shads, etc.		54	43	77	87	34	41	6	28	8	8	10	D
Common sole	Italy, Greece, Spain	1	5	5	8	9	9	9	10	10	9	8	F
Other Flounders,halibuts,soles		3	5	6	7	5	6	5	5	4	6	6	F
31-Flounders,halibuts,soles,..		4	10	11	15	14	15	15	15	14	15	14	F
European hake	Italy, Greece, Spain	12	15	20	36	42	38	33	38	45	52	53	F-O
Whiting	Turkey, Romania, Russian Fed.	0	2	10	20	34	24	22	23	22	21	17	F
Other Cods, hakes, haddocks,..		8	9	13	16	14	13	12	14	19	21	22	
32-Cods, hakes, haddocks,...		20	26	44	72	90	75	67	75	85	95	92	
Bogue	Greece, Algeria, Italy	12	19	24	25	23	32	28	31	30	36	37	M-F
Surmullets(=Red mullets)	Italy, Greece, Spain	12	16	18	20	18	18	19	18	19	20	20	F-O
Picarels	Greece, Turkey, Italy	10	16	17	14	15	16	16	17	17	16	22	F
Porgies, seabreams, nei	Tunisia, Italy, Morocco	1	3	5	7	8	7	6	6	8	7	7	F
European seabass	Greece, Italy, France	0	1	0	1	0	1	1	0	1	1	0	
Red mullet	Turkey, Greece, Tunisia	0	1	2	4	6	7	7	7	9	9	9	F-O
Striped mullet	Turkey, Tunisia, Cyprus	0	1	2	5	7	10	6	7	7	6	6	F-O
Common pandora	Tunisia, France, Israel	1	1	5	8	4	3	4	3	4	3	2	F-O
Gilthead seabream	Turkey, Greece, Italy	0	2	3	3	4	4	4	4	5	5	6	F (+aquacult.)
Common dentex	Italy, Greece, Tunisia	0	1	1	3	4	3	7	4	5	3	3	F-O
Dusky grouper	Italy, Turkey, Greece	0	0	1	2	2	3	3	3	3	3	3	F-O
Other Redfishes,basses,congers		53	67	36	48	52	55	57	54	58	55	64	
33-Redfishes,basses,congers,..		90	128	114	141	143	160	157	155	165	164	179	
Mullets nei	Turkey, Italy, Egypt	10	13	14	15	14	17	19	24	23	21	24	M-O
Flathead grey mullet	Greece, Egypt, Tunisia	2	2	3	4	4	5	5	7	6	6	5	F
Jack and horse mackerels nei	Italy, Algeria, Morocco	30	30	30	32	25	25	22	22	21	22	25	M
Silversides(=Sand smelts)	Turkey, Egypt, Italy	0	3	4	5	10	9	7	9	9	13	10	
Other Jacks, mullets, sauries,		12	22	46	128	144	143	110	63	65	73	64	
34-Jacks, mullets, sauries,...		54	70	98	185	197	199	164	125	123	135	128	

Table V continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
European pilchard(=Sardine)	Algeria, Spain, Italy	102	113	169	245	282	272	247	238	247	251	262	M-F
European anchovy	Turkey, Italy, Spain	118	198	364	562	619	238	171	164	272	322	424	F-O (Med)*
European sprat	Ukraine, Romania, Bulgaria	2	3	17	70	67	105	54	19	21	16	19	D (Black Sea)
Sardinellas nei	Egypt, Tunisia, Algeria	13	15	13	21	21	26	29	31	27	30	27	M-F
Other Herrings,sardines,anchov		1	1	1	1	1	4	4	3	4	4	5	
35-Herrings,sardines,anchovies		237	330	564	899	989	646	504	454	571	623	738	
Atlantic bonito	Turkey, Italy, Greece	30	29	12	23	25	12	22	26	15	26	16	F-O
Swordfish	Italy, Greece, Spain	2	3	5	13	20	18	11	11	13	11	14	F-O
Northern bluefin tuna	France, Italy, Spain	6	6	9	15	17	16	16	17	18	19	28	D
Albacore	Spain, France, Greece	0	0	1	3	4	4	2	2	2	0	0	D
Plain bonito		0	0	0	0	0	0	0	0	0	0	0	F-O
Other Tunas,bonitos,billfishes		4	4	6	9	12	11	15	10	7	4	5	
36-Tunas,bonitos,billfishes,..		41	43	33	63	78	61	65	66	56	60	64	
Chub mackerel	Turkey, Greece, Tunisia	1	3	4	23	38	32	24	20	27	32	34	M-F
Other Mack.,snoeks,cutlassfish		26	25	11	13	13	12	14	13	15	21	16	
37-Mack.,snoeks,cutlassfishes		27	28	16	36	51	44	38	32	42	52	51	
Deepwater rose shrimp	Spain, Algeria, Tunisia	4	2	1	3	2	2	2	3	3	3	3	M-F
Common prawn		0	0	0	0	0	0	0	0	0	0	0	
Other Shrimps, prawns, etc.		9	14	13	25	31	29	36	29	29	26	25	
45-Shrimps, prawns, etc.		12	16	14	27	33	32	38	32	32	29	28	
Mediterranean mussel	Italy, Greece, France	16	29	51	49	28	28	40	33	39	39	32	**
Other Mussels		0	0	0	0	0	0	0	0	0	0	0	
54-Mussels		16	29	51	49	28	28	40	33	39	39	32	
Striped venus	Turkey, Italy, Spain	4	9	23	33	38	39	36	40	55	61	52	F-O
Other Clams, cockles, arkshell		1	2	2	1	2	1	1	2	3	3	2	
56-Clams, cockles, arkshells..		5	11	26	34	39	40	37	42	58	64	55	
Octopuses	Spain, Greece, Cyprus	2	3	5	7	7	6	6	7	7	7	8	F
Common cuttlefish	Italy, Tunisia, Greece	8	16	13	19	26	23	21	19	18	17	23	F
Common squids	Italy, Greece, Spain	4	8	7	8	11	11	10	8	8	8	9	F
Other Squid,cuttlefish,octopus		7	16	20	29	40	37	35	36	40	35	32	
57-Squid,cuttlefish,octopuses		21	42	46	62	83	77	73	69	73	67	71	

Table V continued

Stock or species group	1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Selected groups	582	776	1 093	1 670	1 781	1 418	1 205	1 126	1 265	1 351	1 461	
Other groups	172	139	152	187	191	172	157	158	145	148	153	
Total aquaculture	0	0	0	58	110	125	141	146	165	184	187	
Total productions	754	915	1 245	1 915	2 082	1 715	1 503	1 430	1 575	1 683	1 801	
Total marine capture	754	915	1 245	1 857	1 972	1 590	1 362	1 284	1 410	1 499	1 614	

* (Deplete, BlackSea)
**(Mainly aquaculture)

Table VI . - State of exploitation, total production and nominal catches by selected species groups fished in the Southwest Atlantic (FAO Statistical Area 41), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries 1994	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
31-Flounders,halibuts,soles,..		0	1	4	8	10	12	12	15	13	14	11	
Patagonian grenadier	Argentina, Spain, Falkland Is	0	0	1	21	54	23	11	10	14	46	46	M-F
Argentine hake	Argentina, Uruguay, Brazil	26	142	231	367	433	398	421	521	455	502	487	F-O
Patagonian hake	Argentina, Chile	0	0	0	6	2	3	5	2	4	3	3	
Southern blue whiting	Argentina, Poland, Spain	0	0	6	117	101	132	194	156	133	127	105	M-F
Other Cods, hakes, haddocks,..		0	0	5	48	171	80	46	33	13	18	28	
32-Cods, hakes, haddocks,...		26	142	242	559	762	636	676	722	620	695	670	
Whitemouth croaker	Brazil, Uruguay, Argentina	28	40	69	73	67	61	55	63	70	69	78	M-F-O
Argentine croaker	Brazil, Uruguay, Argentina	2	4	4	10	18	20	20	20	20	19	21	M-F-O
Pink cusk-eel	Argentina, Spain, Uruguay	3	2	3	12	20	22	35	20	25	26	21	M
Patagonian toothfish	Argentina, Falkland Is, Spain	0	0	0	1	1	2	2	2	1	4	6	M
Striped weakfish	Argentina, Uruguay	1	4	9	21	25	21	15	13	19	13	26	M-F-O
Weakfishes nei	Brazil	8	19	39	48	34	35	35	35	35	35	35	
Other Redfishes,basses,congers		29	82	82	93	71	85	72	76	67	71	97	
33-Redfishes,basses,congers,..		71	152	206	257	236	245	234	229	237	237	284	
34-Jacks, mullets, sauries,...		12	42	58	50	40	40	38	39	40	40	40	
Argentine anchoita	Argentina, Uruguay	9	15	24	18	21	21	14	21	19	19	19	U
Brazilian sardinella	Brazil	28	66	155	112	65	78	32	64	65	50	85	O
Other Herrings,sardines,anchov		5	9	16	14	17	10	9	9	9	9	9	
35-Herrings,sardines,anchovies		43	90	195	144	103	109	54	94	93	78	113	
Albacore	Other Asia, Brazil, Japan	0	6	7	7	9	8	12	11	11	13	12	
Bigeye tuna	Other Asia, Japan, Brazil	0	1	2	4	6	7	7	7	8	9	13	
Skipjack tuna	Brazil, Other Asia, Argentina	0	1	1	18	17	21	20	21	19	18	21	
Swordfish	Spain, Other Asia, Brazil	0	1	1	2	3	3	6	6	7	8	9	
Yellowfin tuna	Brazil, Other Asia, Japan	4	3	2	4	5	4	4	4	5	7	8	
Other Tunas,bonitos,billfishes		1	6	8	11	15	14	7	9	6	6	6	
36-Tunas,bonitos,billfishes,..		5	18	21	46	56	58	57	57	57	60	70	
37-Mack.,snoeks,cutlassfishes		14	14	12	30	11	14	10	13	11	13	17	
38-Sharks, rays, chimaeras,...		6	18	25	43	49	46	46	51	49	48	55	

Table VI continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
39-Misc. marine fishes		18	15	70	186	267	247	248	207	218	212	211	
42-Sea-spiders, crabs, etc.		2	12	15	19	18	19	18	18	18	18	19	
Argentine red shrimp	Argentina	2	0	0	10	18	12	10	8	24	18	16	F
Other Shrimps, prawns, etc.		18	33	51	54	48	48	50	41	43	42	42	
45-Shrimps, prawns, etc.		20	34	51	64	65	59	59	49	68	60	58	
Argentine shortfin squid	Argentina, Other Asia, Spain	0	1	18	114	235	225	157	204	200	310	292	F-O
Squids nei	Japan, Korea Rep, Spain	0	1	4	229	392	465	347	460	494	371	257	F-O
Patagonian squid	Falkland Is, Poland	0	0	0	5	8	15	12	8	11	5	6	F-O
Other Squid,cuttlefish,octopus		0	1	1	24	46	57	36	25	7	9	9	
57-Squid,cuttlefish,octopuses		1	3	24	372	681	762	553	697	712	696	563	
Selected groups		218	541	921	1 778	2 298	2 247	2 007	2 192	2 135	2 171	2 112	
Other groups		5	14	21	18	19	18	19	19	15	18	22	
Total aquaculture		0	0	0	0	1	1	2	2	2	2	2	
Total productions		223	555	942	1 796	2 318	2 266	2 028	2 213	2 152	2 191	2 136	
Total marine capture		223	555	942	1 796	2 317	2 265	2 026	2 211	2 150	2 189	2 134	

Table VII . - State of exploitation, total production and nominal catches by selected species groups fished in the Southeast Atlantic (FAO Statistical Area 47), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Cape hakes	South Africa, Namibia, Spain	68	320	736	457	501	465	268	181	206	199	266	F?
Other Cods, hakes, haddocks,..		0	0	8	6	0	0	0	0	0	0	0	
32-Cods, hakes, haddocks,...		68	320	744	463	501	466	268	181	206	199	266	
Kingklip	South Africa, Namibia, Korea Rep	1	2	11	11	10	8	5	2	3	3	4	O
Cape monk	Namibia, South Africa	0	0	4	7	9	8	7	10	11	13	16	?
Panga seabream	South Africa, Namibia	3	3	8	2	2	2	2	1	1	1	1	M
Other Redfishes,basses,congers		24	54	72	64	51	37	30	14	17	19	21	
33-Redfishes,basses,congers,..		28	60	96	85	72	55	44	28	32	37	42	
Cape horse mackerel	Russian Fed., Ukraine, Namibia	75	82	346	560	584	506	336	440	372	387	284	M/F
Cunene horse mackerel	Russian Fed., Angola, Korea Rep	66	124	170	108	131	159	116	86	104	102	100	F
Other Jacks, mullets, sauries,		15	23	46	50	31	34	21	5	25	32	6	
34-Jacks, mullets, sauries,...		155	228	562	717	745	699	474	531	501	521	389	
Southern African pilchard	Namibia, South Africa, Ukraine	364	991	461	96	105	114	149	121	134	167	210	F
Sardinellas nei	Angola, Russian Fed., Lithuania	49	69	109	159	136	106	57	57	15	17	36	F
Whitehead's round herring	South Africa, Namibia	0	5	27	41	62	44	45	33	47	56	56	U
Southern African anchovy	South Africa, Namibia	0	148	448	476	682	373	201	168	386	299	181	F
Other Herrings,sardines,anchov		0	0	22	5	0	0	0	0	0	0	0	
35-Herrings,sardines,anchovies		412	1 213	1 066	778	985	638	451	380	582	539	482	
Albacore	Other Asia, South Africa, Portugal	0	9	15	17	19	17	18	15	19	18	18	F
Bigeye tuna	Japan, Other Asia, Portugal	0	3	7	13	14	17	15	13	14	21	26	F?
Southern bluefin tuna	Japan, Other Asia	0	0	7	5	2	2	2	3	3	4	2	O
Other Tunas,bonitos,billfishes		11	12	11	10	13	17	11	9	10	11	12	
36-Tunas,bonitos,billfishes,..		11	25	39	45	49	53	46	41	46	54	57	
Snoek	South Africa, Namibia, Russian Fed.	14	11	20	39	24	35	24	23	20	16	14	F?
Other Mack.,snoeks,cutlassfish		29	73	99	51	37	51	39	29	19	17	10	
37-Mack.,snoeks,cutlassfishes		43	84	119	89	60	85	63	52	39	33	25	
39-Misc. marine fishes		98	85	97	83	46	60	31	17	19	14	17	
Geryons nei	Japan	0	0	3	6	8	6	2	7	3	7	5	F?
Other Sea-spiders, crabs, etc.		0	0	0	0	0	0	0	0	0	0	0	
42-Sea-spiders, crabs, etc.		0	0	3	6	8	6	2	7	3	7	5	

Table VII continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Cape rock lobster	South Africa, Namibia	20	16	9	7	7	5	4	2	2	2	2	O
Southern spiny lobster		0	0	1	1	1	1	1	1	1	1	1	F
Other Lobsters,spinyrock lobst		0	1	1	0	0	0	0	0	0	0	0	
43-Lobsters,spinyrock lobsters		20	16	11	8	8	6	6	4	4	3	3	
45-Shrimps, prawns, etc.		0	0	7	4	6	5	5	5	5	6	6	F
Perlemoen abalone	South Africa	0	2	1	1	1	1	1	1	1	1	1	F?
Other Abalones,winkles,conchs,		0	0	0	0	0	0	0	0	0	0	0	
52-Abalones,winkles,conchs,...		0	2	1	1	1	1	1	1	1	1	1	
53-Oysters		0	0	0	0	0	1	1	1	0	0	0	
Sea mussels nei	South Africa	0	0	0	0	0	1	1	2	2	2	2	
Other Mussels		0	0	0	0	0	0	0	0	0	0	0	
54-Mussels		0	0	0	0	0	1	1	2	2	2	2	
Selected groups		837	2 034	2 746	2 279	2 483	2 074	1 393	1 248	1 442	1 417	1 296	
Other groups		3	9	15	22	20	28	17	15	14	16	16	
Total aquaculture		0	0	0	0	0	1	1	1	1	1	1	
Total productions		840	2 043	2 761	2 301	2 503	2 103	1 411	1 264	1 457	1 434	1 313	
Total marine capture		840	2 043	2 761	2 301	2 503	2 102	1 410	1 263	1 456	1 433	1 312	

Table VIII. - State of exploitation, total production and nominal catches by selected species groups fished in the Western Indian Ocean (FAO Statistical Area 51), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t)											State of exploitation
		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	
Sea catfishes nei	Pakistan, India, Yemen	26	29	59	49	57	48	49	58	57	71	78	?
Emperors(=Scavengers)	Untd Arab Em, Saudi Arabia, Mauritius	2	8	10	27	42	39	36	42	45	43	41	?
Croakers, drums nei	India, Pakistan, Oman	29	29	70	134	151	199	218	238	258	272	296	?
Demersal percomorphs nei	Egypt, Sri Lanka, Oman	15	25	38	39	18	30	33	33	25	30	35	?
Lizardfishes nei	India, Egypt, Saudi Arabia	1	3	5	8	7	10	9	18	20	23	23	?
Bombay-duck	India, Pakistan	67	83	108	100	98	117	125	143	154	142	127	F
Other Redfishes,basses,congers		41	45	70	115	149	142	147	187	194	150	160	?
33-Redfishes,basses,congers,..		181	222	360	471	521	584	617	719	753	732	760	?
Barracudas	Pakistan, India, Untd Arab Em	1	2	3	8	10	11	12	14	15	15	16	?
Carangids nei	Pakistan, Sri Lanka, Untd Arab Em	2	10	19	44	46	82	99	61	61	46	44	?
Mullets nei	Pakistan, India, Tanzania	0	1	6	10	12	14	13	13	16	28	27	?
Jacks, crevalles, nei	India, Egypt, Untd Arab Em	10	12	15	19	31	36	62	89	88	82	77	?
Pelagic percomorphs nei	Yemen, Oman, Kenya	50	68	165	99	85	73	75	96	76	47	45	?
Butterfishes, silver pomfrets	India, Pakistan, Kuwait	13	18	25	32	28	31	26	34	27	26	34	?
Pompanos	India	0	0	0	3	0	33	0	36	50	53	55	?
Other Jacks, mullets, sauries,		4	10	21	27	39	38	25	33	45	34	33	?
34-Jacks, mullets, sauries,...		81	121	254	242	252	318	311	376	377	331	331	?
Wolf-herrings	India, Untd Arab Em	2	5	6	11	11	16	21	9	10	8	9	?
Indian oil sardine	Pakistan, India, Oman	64	215	193	240	210	259	294	209	214	201	138	F
Sardinellas nei	Untd Arab Em, Tanzania, Egypt, Comor	3	7	7	16	27	28	23	15	17	19	20	F
Stolephorus anchovies	Untd Arab Em	2	4	0	7	7	7	8	8	8	8	9	?
Anchovies nei	India, Pakistan, Comoros	14	15	36	50	55	56	94	89	89	54	42	?
Clupeoids nei	Sri Lanka, India, Pakistan	39	61	65	94	123	118	135	159	170	131	98	?
Dorab wolf-herring	Pakistan	0	0	2	4	1	1	1	1	1	1	1	?
Other Herrings,sardines,anchov		0	0	0	0	0	0	0	0	0	0	0	
35-Herrings,sardines,anchovies		124	306	310	423	435	484	574	488	508	422	318	?
Narrow-barred Spanish mackerel	India, Pakistan, Untd Arab Em	5	13	12	40	58	42	36	34	40	41	41	F
Kawakawa	India, Untd Arab Em, Maldives	0	1	2	20	30	17	22	21	21	29	31	?
Tuna-like fishes nei	Russian Fed., Madagascar, Mozambiqu	2	9	21	20	24	22	30	24	41	37	42	
Bigeye tuna	Other Asia, Japan, Korea Rep	0	9	16	30	42	34	34	37	32	44	52	?F
Skipjack tuna	Maldives, Spain, France, Sri Lanka	17	26	32	110	198	230	207	207	257	232	239	MF
Yellowfin tuna	Spain, France, Other Asia	2	23	26	85	169	140	157	165	220	300	226	?F
Other Tunas,bonitos,billfishes		6	29	47	76	96	111	139	133	109	120	127	
36-Tunas,bonitos,billfishes,..		32	111	156	380	617	595	625	620	720	803	758	

Table VIII continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Natantian decapods nei	India, Madagascar, Iran I R	96	88	184	174	120	122	128	155	124	110	118	F
Penaeus shrimps nei	India, Pakistan, Mozambique	7	17	28	53	118	103	112	147	151	150	168	F
Knife shrimp	Mozambique	0	0	0	2	5	4	4	3	2	2	2	F
Jack-knife shrimp	Spain	0	0	0	1	1	1	1	1	1	1	1	F
Indian white prawn	Spain, Saudi Arabia	0	0	0	1	1	1	1	1	1	1	1	F
Other Shrimps, prawns, etc.		0	0	2	1	1	0	1	1	0	0	0	
45-Shrimps, prawns, etc.		103	105	213	231	245	232	247	307	279	265	291	
Selected groups		521	865	1 294	1 747	2 070	2 214	2 375	2 511	2 636	2 553	2 458	
Other groups		221	291	591	789	914	1 182	947	1 018	1 123	1 143	1 209	
Total aquaculture		0	0	0	4	7	10	11	12	13	24	30	
Total productions		742	1 156	1 885	2 540	2 991	3 406	3 333	3 541	3 772	3 720	3 697	
Total marine capture		742	1 156	1 885	2 536	2 984	3 396	3 322	3 529	3 759	3 696	3 667	

Table IX. - State of exploitation, total production and nominal catches by selected species groups fished in the Eastern Indian Ocean (57), in metric tonnes, years 1950-94

Catches ('000t)		Catches (000t)											
Stock or species group	Main fishing countries in 94	1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Toli shad	Bangladesh, Indonesia	0	0	0	53	106	111	111	115	126	130	121	F
Kelee shad	India	2	5	9	18	20	23	23	31	37	41	35	
Chacunda gizzard shad	Malaysia	0	0	1	2	2	2	3	3	2	3	3	M
Diadromous clupeoids nei		0	0	0	0	0	0	0	0	0	0	0	
Indian pellona	Malaysia	0	0	0	3	5	4	5	5	6	6	7	
Other Shads, etc.		0	0	0	0	0	0	0	0	0	0	0	
24-Shads, etc.		2	5	10	76	132	140	142	154	170	180	167	
Sea catfishes nei	India, Indonesia, Malaysia	7	9	20	34	34	46	46	53	57	79	66	
Percoids nei	India	4	5	9	24	29	32	29	31	33	34	32	
Croakers, drums nei	India, Thailand, Malaysia	18	12	29	46	55	50	41	52	57	63	65	F
Ponyfishes(=Slipmouths)nei	India, Indonesia	11	18	31	39	39	45	49	48	49	53	60	F
Threadfin breams	Thailand, Malaysia, Indonesia	0	1	5	12	14	15	20	26	27	34	34	F
Other Redfishes,basses,congers		14	20	39	62	82	92	103	114	110	118	127	
33-Redfishes,basses,congers,..		54	65	132	216	251	281	288	324	333	380	385	
Mullets nei	India, Malaysia, Indonesia	3	4	5	16	34	29	29	35	35	16	14	
Carangids nei	Indonesia, Thailand, India	1	2	6	21	31	30	34	32	25	43	49	
Jacks, crevalles, nei	India, Indonesia, Malaysia	9	10	12	23	29	26	24	24	24	22	25	
Butterfishes, silver pomfrets	India, Malaysia	3	4	7	18	15	15	15	16	12	27	32	
Indian scad	Malaysia, Thailand	4	5	7	20	29	36	38	31	15	19	19	
Other Jacks, mullets, sauries,		10	15	35	71	107	88	91	111	100	101	124	
34-Jacks, mullets, sauries,...		29	41	72	169	245	224	231	248	212	229	263	
Anchovies nei	Thailand, India, Australia	13	18	19	29	17	15	18	31	51	56	56	
Clupeoids nei	India, Australia, Malaysia	27	30	36	24	31	21	30	34	27	24	28	
Stolephorus anchovies	Indonesia, Malaysia	9	17	27	48	52	54	52	48	58	51	52	
Indian oil sardine	India	0	0	27	56	41	42	45	45	57	65	66	F
Sardinellas nei	Thailand	0	0	2	24	33	30	28	25	21	38	39	F
Other Herrings,sardines,anchov		4	7	14	34	41	43	43	49	44	88	90	
35-Herrings,sardines,anchovies		54	72	126	214	215	203	215	231	257	323	332	
Narrow-barred Spanish mackerel	Indonesia, India, Australia	1	1	2	13	25	23	13	14	16	19	21	
Kawakawa	India, Thailand, Malaysia	0	1	3	9	11	17	26	29	33	31	29	F
Seerfishes nei	Malaysia, Thailand, Australia	3	6	13	9	7	6	7	8	10	8	8	
Skipjack tuna	Indonesia, Australia, Other Asia	1	2	5	13	14	19	15	17	24	17	18	F
Tuna-like fishes nei	Indonesia, India, Bangladesh	3	5	10	31	36	46	45	50	41	45	48	
Other Tunas,bonitos,billfishes		13	41	42	74	86	100	84	83	71	81	85	F
36-Tunas,bonitos,billfishes,..		21	56	75	149	179	211	190	201	194	202	209	

Table IX continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Snoek	Australia	2	2	1	0	0	0	0	0	0	0	0	
Hairtails, cutlassfishes, nei	India, Indonesia	19	13	27	30	25	16	21	19	20	18	27	
Indian mackerels nei	Thailand, Malaysia, Indonesia	12	28	31	101	91	104	124	116	127	158	190	
Indian mackerel	India, Thailand	6	4	12	19	24	20	27	40	33	48	40	M-F
Largehead hairtail	Thailand, Malaysia	0	0	2	3	7	4	4	5	7	7	6	
Other Mack.,snoeks,cutlassfish		0	0	0	1	2	1	2	2	3	3	4	
37-Mack.,snoeks,cutlassfishes		39	49	73	156	149	145	178	181	191	235	267	
Marine fishes nei	Myanmar, Thailand, Malaysia	215	388	663	1 022	1 109	1 219	1 306	1 367	1 479	1 538	1 479	
39-Misc. marine fishes		215	388	663	1 022	1 109	1 219	1 306	1 367	1 479	1 538	1 479	
Natantian decapods nei	Malaysia, Bangladesh, India	22	31	74	106	93	117	117	92	132	109	99	
Giant tiger prawn	Thailand, Indonesia, Malaysia	0	0	0	2	3	4	4	3	4	4	4	
Banana prawn	Indonesia, Thailand, Malaysia	0	1	4	9	9	11	8	9	8	11	11	
Penaeus shrimps nei	India, Thailand	0	0	3	7	22	24	26	33	29	11	11	F
Sergestid shrimps	Malaysia, Thailand	0	0	1	13	16	3	3	16	3	20	9	
Other Shrimps, prawns, etc.		1	1	4	6	7	7	6	7	6	7	7	
45-Shrimps, prawns, etc.		24	33	86	143	151	166	163	159	183	161	142	
Cuttlefishes, bobtail squids	Thailand, Malaysia, Indonesia	1	1	6	9	8	13	12	20	24	24	26	M-F
Common squids	Thailand, Indonesia, Australia	0	1	3	8	10	10	9	15	16	19	20	M-F
Octopuses	Thailand, Indonesia, Malaysia	0	0	0	1	1	2	3	7	6	8	8	
Cephalopods nei	India	0	0	1	11	27	49	10	6	13	8	11	
Squids nei	Malaysia	0	0	2	10	11	16	15	15	19	12	11	
Other Squid,cuttlefish,octopus		0	0	0	0	0	0	0	0	0	0	0	
57-Squid,cuttlefish,octopuses		1	2	12	39	56	90	50	63	78	71	76	
Selected groups		438	711	1 249	2 185	2 489	2 678	2 763	2 929	3 097	3 318	3 320	
Other groups		29	69	126	245	230	223	182	179	237	282	264	
Total aquaculture		0	0	0	44	71	85	84	116	139	204	224	
Total productions		467	780	1 375	2 474	2 790	2 986	3 029	3 224	3 473	3 804	3 808	
Total marine capture		467	780	1 375	2 430	2 719	2 901	2 945	3 108	3 334	3 600	3 584	

Table X. - State of exploitation, total production and nominal catches by selected species groups fished in the Northwest Pacific (FAO Statistical Area 61), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Chum(=Keta=Dog)salmon	Japan, Russian Fed.	83	65	84	149	174	184	232	204	164	209	220	
Pink(=Humpback)salmon	Russian Fed., Japan	132	93	96	95	51	164	83	236	100	129	132	
Other Salmons, trouts, smelts,		43	49	34	20	17	12	12	13	21	20	15	
23-Salmons, trouts, smelts,...		258	206	214	263	242	360	326	454	284	357	367	
Alaska pollock(=Walleye poll.)	Russian Fed., Japan, Korea Rep	199	882	3 289	4 292	5 108	4 827	4 207	3 521	3 523	3 048	2 823	F
Pacific cod	Russian Fed., Japan, Korea Rep	45	71	82	180	208	201	181	157	234	170	151	F
Other Cods, hakes, haddocks,..		13	20	45	66	53	40	43	49	61	52	27	F
32-Cods, hakes, haddocks,...		258	973	3 416	4 538	5 370	5 068	4 431	3 727	3 819	3 270	3 001	
Yellow croaker	China, Korea Rep, Other Asia	93	115	69	50	46	39	53	86	104	111	144	F-O
Other Redfishes,basses,congers		534	728	1 277	1 237	1 154	1 223	1 339	1 198	1 055	965	1 158	F
33-Redfishes,basses,congers,..		627	844	1 345	1 287	1 201	1 262	1 391	1 284	1 158	1 076	1 302	F
Japanese jack mackerel	Japan, Korea Rep, Other Asia	229	455	154	149	268	205	240	239	251	350	365	F
Pacific saury	Japan, Korea Rep, Russian Fed.	372	341	309	261	347	331	436	402	382	400	335	F
Other Jacks, mullets, sauries,		118	171	325	607	563	666	787	797	723	587	775	
34-Jacks, mullets, sauries,...		719	968	788	1 016	1 177	1 202	1 462	1 439	1 355	1 338	1 475	
Pacific herring	Russian Fed., Korea Rep, Japan	304	367	357	176	213	118	109	120	120	122	93	F
Japanese anchovy	China, Korea Rep, Japan	364	417	398	343	304	316	536	614	663	1 001	821	M
Japanese pilchard	Japan, China, Korea Rep	228	47	795	4 560	5 429	5 143	4 732	3 774	2 489	1 796	1 294	M (D)
Other Herrings,sardines,anchov		94	99	128	147	175	159	136	142	138	153	161	
35-Herrings,sardines,anchovies		990	930	1 679	5 227	6 121	5 736	5 514	4 650	3 409	3 072	2 368	
36-Tunas,bonitos,billfishes,..		289	439	398	464	539	516	597	611	544	636	595	
Largehead hairtail	China, Korea Rep, Japan	342	505	622	617	531	591	655	706	759	742	1 030	F
Chub mackerel	Japan, China, Korea Rep	338	717	1 672	1 272	1 138	981	612	618	669	1 153	1 235	M (R)
Other Mack.,snoeks,cutlassfish		1	1	3	4	4	4	3	13	5	4	3	
37-Mack.,snoeks,cutlassfishes		680	1 224	2 297	1 892	1 672	1 576	1 269	1 336	1 433	1 899	2 268	
38-Sharks, rays, chimaeras,...		118	93	109	98	74	92	108	104	99	102	72	
39-Misc. marine fishes		1 239	2 107	3 183	4 046	4 583	4 709	4 611	4 661	5 181	5 285	5 339	

Table X continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Gazami crab	China, Korea Rep, Japan	3	2	14	64	135	175	163	172	176	146	317	
Other Sea-spiders, crabs, etc.		221	316	374	443	491	571	541	651	679	828	889	
42-Sea-spiders, crabs, etc.		224	318	388	508	625	746	704	822	856	973	1 206	
Akiami paste shrimp	China, Korea Rep	78	99	92	189	202	239	236	235	258	287	345	
Other Shrimps, prawns, etc.		49	95	170	265	366	254	272	222	233	248	274	
45-Shrimps, prawns, etc.		127	194	263	454	568	493	508	457	491	535	619	
Yesso scallop	China, Japan, Russian Fed.	16	10	82	155	163	192	232	181	197	227	274	
Other Scallops, pectens, etc.		0	0	0	0	0	0	0	0	0	0	0	
55-Scallops, pectens, etc.		16	10	82	155	163	192	232	181	197	227	274	
Japanese carpet shell	China, Japan, Korea Rep	70	132	160	148	106	99	83	87	71	87	60	
Other Clams, cockles, arkshell		125	186	194	182	184	167	177	152	140	160	146	
56-Clams, cockles, arkshells..		195	318	354	330	290	265	260	239	211	247	206	
Squids nei	China, Japan, Other Asia	82	112	198	357	359	448	436	331	298	262	362	M
Japanese flying squid	Japan, Korea Rep	428	530	355	238	206	278	285	352	534	538	493	M (R)
Other Squid,cuttlefish,octopus		46	68	97	142	126	153	141	133	110	106	103	
57-Squid,cuttlefish,octopuses		556	710	650	737	691	878	862	816	942	906	958	
Selected groups		6 296	9 332	15 165	21 015	23 317	23 095	22 276	20 780	19 979	19 923	20 049	
Other groups		486	917	1 069	952	814	713	704	779	1 050	1 031	1 085	
Total aquaculture		0	0	0	1 176	2 481	2 458	2 540	2 673	3 080	3 653	3 882	
Total productions		6 782	10 249	16 234	23 143	26 612	26 266	25 520	24 232	24 109	24 607	25 016	
Total marine capture		6 782	10 249	16 234	21 967	24 131	23 808	22 980	21 559	21 029	20 954	21 134	

Table XI. - State of exploitation, total production and nominal catches by selected species groups fished in the Northeast Pacific (FAO Statistical Area 67), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Chinook(=Spring=King)salmon	Canada, USA	17	15	20	17	14	13	12	10	10	10	9	F - O
Chum(=Keta=Dog)salmon	USA, Canada	48	29	38	57	90	40	49	41	56	57	79	F
Coho(=Silver)salmon	USA, Canada	24	25	26	28	22	26	32	31	30	23	40	F - O
Pink(=Humpback)salmon	USA, Canada	65	75	66	140	111	197	150	198	107	171	169	F
Sockeye(=Red)salmon	USA, Canada	49	52	58	125	96	158	181	146	177	221	169	F
Other Salmons, trouts, smelts,		1	1	1	1	0	0	0	0	0	0	0	
23-Salmons, trouts, smelts,...		205	197	209	368	332	434	422	426	381	481	466	
Pacific halibut	USA, Canada	22	39	20	29	43	39	37	34	35	34	32	F
Yellowfin sole	USA	0	0	66	137	219	153	150	71	124	106	108	U
Other Flounders,halibuts,soles		24	119	142	130	179	110	155	85	139	156	70	U - F
31-Flounders,halibuts,soles,..		46	157	227	297	441	302	342	189	298	295	210	
North Pacific hake	USA	0	60	166	150	199	241	184	31	56	141	253	
Alaska pollock(=Walleye poll.)	USA, China, Korea Rep	79	309	976	1 319	1 550	1 494	1 529	1 372	1 463	1 568	1 476	F
Pacific cod	USA, Canada, Japan	21	40	71	154	245	222	261	263	260	227	226	U - D
Other Cods, hakes, haddocks,..		0	0	0	0	0	0	0	0	0	0	0	
32-Cods, hakes, haddocks,...		101	408	1 212	1 624	1 993	1 957	1 974	1 666	1 779	1 936	1 955	
Sablefish	USA, Canada	3	7	38	34	52	45	43	41	37	38	36	F
Pacific ocean perch	USA, Canada	29	210	75	29	33	32	49	37	46	43	26	D
Other Redfishes,basses,congers		10	29	93	88	77	78	96	69	113	124	102	F
33-Redfishes,basses,congers,..		41	247	206	150	161	156	188	148	196	206	163	
Pacific herring	USA, Canada	189	201	107	80	84	85	82	88	101	85	89	M - O
Japanese pilchard		0	0	0	0	0	0	0	0	0	0	0	
Other Herrings,sardines,anchov		0	0	0	0	0	0	0	0	0	0	0	
35-Herrings,sardines,anchovies		189	201	107	80	84	85	82	88	102	85	89	
Chub mackerel	USA	0	0	0	0	0	1	0	0	1	0	0	F
Other Mack.,snoeks,cutlassfish		0	0	0	0	0	0	0	0	0	0	0	
37-Mack.,snoeks,cutlassfishes		0	0	0	0	0	1	0	0	1	0	0	
Dungeness crab	USA, Canada	9	14	16	15	21	19	16	11	21	31	25	F
King crabs	USA	5	52	46	21	10	12	15	13	9	11	5	F (D)
Pacific snow crabs	USA	3	10	42	47	66	75	97	162	159	116	72	F
Other Sea-spiders, crabs, etc.		0	0	0	1	0	0	0	0	2	1	1	F
42-Sea-spiders, crabs, etc.		16	75	104	85	97	106	128	186	191	159	104	

Table XI continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Pacific shrimps	USA	1	14	61	26	33	36	26	20	37	24	17	F - O - D
Other Shrimps, prawns, etc.		0	1	1	2	3	2	2	4	4	4	4	
45-Shrimps, prawns, etc.		2	14	62	27	37	39	28	24	41	28	21	
Selected groups		599	1 300	2 128	2 631	3 145	3 080	3 165	2 729	2 989	3 190	3 007	
Other groups		52	88	98	121	157	154	169	181	129	138	147	
Total aquaculture		0	0	0	26	50	49	53	58	57	67	90	
Total productions		651	1 388	2 226	2 778	3 352	3 283	3 387	2 968	3 175	3 395	3 244	
Total marine capture		651	1 388	2 226	2 752	3 302	3 234	3 334	2 910	3 118	3 328	3 154	

Table XII. - State of exploitation, total production and nominal catches by selected species groups fished in the Western Central Pacific (71), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t)											State of exploitation
		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	
Toli shad	Indonesia	0	1	1	2	2	2	3	3	4	4	5	M - F
Chacunda gizzard shad	Malaysia, Philippines	0	0	1	1	1	2	2	1	1	1	2	
Diadromous clupeoids nei	Malaysia	1	2	1	1	0	1	1	1	0	0	3	
Indian pellona	Malaysia	0	0	1	1	1	2	1	3	3	2	4	
Big eye ilisha	Philippines	0	0	0	0	0	0	1	1	1	1	1	M
Other Shads, etc.		0	0	0	0	0	0	0	0	0	0	0	
24-Shads, etc.		1	2	5	5	5	6	8	9	10	9	16	
Sea catfishes nei	Indonesia, Malaysia, Thailand	5	10	27	41	55	47	49	53	55	71	69	M
Percoids nei	Philippines, Kiribati, Malaysia	142	28	35	36	37	40	41	46	31	43	40	
Lizardfishes nei	Thailand, Philippines, Indonesia	0	27	30	25	29	30	27	35	48	57	61	M - D
Ponyfishes(=Slipmouths)nei	Philippines, Indonesia	5	52	85	94	98	98	103	106	98	105	106	M - D
Threadfin breams	Thailand, Philippines, Indonesia	2	27	70	79	108	103	101	113	119	137	136	M - F
Other Redfishes,basses,congers		35	99	225	323	368	373	371	399	402	473	495	
33-Redfishes,basses,congers,..		190	243	471	598	696	691	693	750	755	886	908	
Mullets nei	Indonesia, Philippines, Thailand	6	9	21	36	43	42	42	44	51	50	57	
Carangids nei	Indonesia, Philippines, Thailand	13	34	80	128	167	153	148	153	173	172	180	
Flyingfishes nei	Philippines, Indonesia, Kiribati	5	9	25	33	29	31	30	32	67	26	26	
Scads	Philippines, Indonesia, Singapore	43	203	245	271	286	334	393	457	467	452	423	M - F
Indian scad	Malaysia, Thailand	5	6	52	47	41	46	47	69	80	100	99	
Bigeye scad	Philippines	4	27	46	35	37	39	41	36	38	33	50	
Other Jacks, mullets, sauries,		34	62	137	203	237	242	241	260	292	314	312	
34-Jacks, mullets, sauries,...		109	351	607	752	839	887	943	1 051	1 168	1 148	1 147	
Sardinellas nei	Philippines, Thailand, Fiji	0	31	180	212	188	238	249	274	339	371	376	
Goldstripe sardinella	Indonesia	13	23	48	102	119	127	122	123	129	138	142	
Bali sardinella	Indonesia	7	12	30	63	87	91	104	134	126	73	80	F
Stolephorus anchovies	Indonesia, Philippines, Malaysia	52	72	125	191	222	219	215	211	199	198	186	
Anchovies nei	Thailand, Malaysia	0	0	18	58	69	97	123	115	123	124	127	M - F
Other Herrings,sardines,anchov		13	30	81	79	95	89	83	83	78	75	98	
35-Herrings,sardines,anchovies		86	168	482	705	779	860	896	940	995	978	1 008	

Table XII continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Tuna-like fishes nei	Indonesia, Russian Fed., Japan	11	20	39	89	93	107	108	117	125	144	135	
Yellowfin tuna	Indonesia, Philippines, Japan	3	7	100	205	208	273	327	335	339	321	348	F
Skipjack tuna	Japan, Korea Rep, Indonesia	47	68	221	463	658	626	733	890	721	705	785	F
Frigate and bullet tunas	Philippines, Thailand, Japan	0	3	35	96	132	131	109	116	160	143	142	
Kawakawa	Thailand, Philippines, Malaysia	30	24	48	91	105	108	91	110	112	105	118	M
Other Tunas,bonitos,billfishes		35	48	99	181	232	246	271	233	257	232	226	
36-Tunas,bonitos,billfishes,..		127	171	542	1 125	1 429	1 491	1 639	1 802	1 713	1 650	1 753	
Indian mackerel	Philippines, Thailand, Fiji	0	0	52	70	73	81	90	82	95	95	97	
Hairtails, cutlassfishes, nei	Philippines, Indonesia, Korea Rep	1	9	13	20	29	23	28	27	31	31	35	
Indian mackerels nei	Indonesia, Thailand, Malaysia	76	123	130	191	206	221	193	194	257	228	226	
Largehead hairtail	Malaysia, Thailand, Singapore	0	1	7	6	6	5	6	5	5	6	6	
Short mackerel	Philippines	0	21	26	25	28	23	23	28	24	26	28	
Other Mack.,snoeks,cutlassfish		2	2	5	6	1	1	1	2	3	5	14	
37-Mack.,snoeks,cutlassfishes		80	156	233	318	343	354	340	337	415	390	406	
Marine fishes nei	Thailand, Viet Nam, Indonesia	296	1 028	1 455	1 580	1 766	1 718	1 793	1 720	1 758	1 859	1 944	
Other Misc. marine fishes		0	0	0	0	0	0	0	0	0	0	0	
39-Misc. marine fishes		296	1 028	1 455	1 580	1 766	1 718	1 793	1 720	1 758	1 859	1 944	
Natantian decapods nei	Viet Nam, Indonesia, Malaysia	20	38	108	139	178	186	194	205	220	209	213	
Banana prawn	Indonesia, Thailand, Papua N Guin	10	17	34	37	38	37	40	37	45	40	42	F
Sergestid shrimps	Thailand, Philippines, Malaysia	0	0	20	37	45	39	39	40	43	39	43	M - F
Penaeus shrimps nei	Thailand, Philippines, NewCaledonia	20	61	81	93	73	72	66	79	73	74	72	
Other Shrimps, prawns, etc.		6	10	32	30	25	16	14	15	15	12	15	
45-Shrimps, prawns, etc.		55	126	275	336	360	350	354	376	396	373	386	
Cuttlefishes, bobtail squids	Thailand, Viet Nam, Malaysia	4	5	36	58	68	79	81	90	97	94	97	M - F
Common squids	Thailand, Philippines, Other Asia	7	13	68	108	138	131	136	150	149	176	165	M - F
Octopuses	Thailand, Philippines, Kiribati	0	0	5	12	15	21	21	20	21	26	24	
Squids nei	Malaysia, Korea Rep, Japan	0	0	1	7	11	16	23	20	19	22	28	
Other Squid,cuttlefish,octopus		0	0	0	0	0	0	0	0	0	0	0	
57-Squid,cuttlefish,octopuses		11	19	109	184	231	248	261	281	287	317	314	
Selected groups		955	2 264	4 180	5 603	6 448	6 604	6 927	7 267	7 496	7 611	7 881	
Other groups		84	169	351	448	556	544	571	620	733	662	691	
Total aquaculture		0	0	0	74	153	213	241	273	268	332	369	
Total productions		1 039	2 433	4 531	6 125	7 157	7 361	7 739	8 160	8 497	8 605	8 941	
Total marine capture		1 039	2 433	4 531	6 051	7 004	7 148	7 498	7 887	8 229	8 273	8 572	

Table XIII. - State of exploitation, total production and nominal catches by selected species groups fished in the Eastern Central Pacific (FAO Statistical Area 77), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
32-Cods, hakes, haddocks,...		0	0	4	1	0	0	0	0	0	1	0	?-U
33-Redfishes,basses,congers,..		14	25	48	44	34	32	37	38	39	38	34	U-M-O
Pacific jack mackerel	USA	32	32	23	15	10	13	4	2	1	2	3	U
Other Jacks, mullets, sauries,		4	5	6	9	10	9	8	8	10	8	7	
34-Jacks, mullets, sauries,...		36	37	29	23	20	22	12	10	12	9	9	
California pilchard	Mexico	86	28	100	404	446	509	399	467	251	194	266	M-F
Californian anchovy	USA, Mexico	16	23	165	207	119	111	6	21	10	5	4	(D),M-F
Pacific thread herring	Panama	0	7	18	17	40	18	23	36	33	30	41	U-M
Pacific anchoveta	Panama	1	23	70	111	39	121	62	65	70	89	72	M-F
Other Herrings,sardines,anchov		2	0	3	10	8	11	10	9	7	5	4	
35-Herrings,sardines,anchovies		105	81	357	748	653	770	500	598	370	323	387	
Skipjack tuna	USA, Mexico, Japan	53	40	81	91	86	80	43	41	77	59	52	
Yellowfin tuna	Mexico, Venezuela, USA	65	84	177	206	283	275	257	213	233	227	234	
Bigeye tuna	Japan, Korea Rep, USA	0	22	55	74	80	76	91	91	93	83	77	
Albacore	USA, Other Asia, Japan	17	15	18	24	25	21	16	12	16	13	12	
Northern bluefin tuna	USA, Japan, Mexico	6	10	9	2	1	1	1	0	1	1	1	
Other Tunas,bonitos,billfishes		9	29	36	35	41	42	47	33	36	37	38	
36-Tunas,bonitos,billfishes,..		149	199	375	432	516	495	457	389	455	420	413	
Chub mackerel	Mexico, USA	16	14	8	45	51	60	78	68	38	31	22	M
Other Mack.,snoeks,cutlassfish		0	0	0	0	0	0	0	0	0	0	0	
37-Mack.,snoeks,cutlassfishes		16	14	8	45	51	60	78	68	38	31	22	
39-Misc. marine fishes		14	63	108	131	122	110	179	167	231	248	232	
Dungeness crab	USA	6	4	1	1	2	0	0	1	1	1	2	
Other Sea-spiders, crabs, etc.		1	1	1	2	3	5	5	3	3	3	5	
42-Sea-spiders, crabs, etc.		6	4	2	3	5	5	6	4	4	4	7	
45-Shrimps, prawns, etc.		51	69	63	75	68	72	50	54	51	64	67	F-O
53-Oysters		2	5	3	5	6	6	6	6	5	5	6	

Table XIII continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Squids nei	USA, Korea Rep, Panama	5	7	12	36	75	72	73	57	30	34	56	U-M
Other Squid,cuttlefish,octopus		0	0	1	4	2	9	7	7	9	4	3	U
57-Squid,cuttlefish,octopuses		5	7	13	40	77	81	80	65	40	38	59	
Selected groups		400	505	1 009	1 546	1 552	1 653	1 405	1 400	1 245	1 182	1 237	
Other groups		34	36	42	81	103	94	102	97	97	75	76	
Total aquaculture		0	0	0	3	9	8	13	14	19	25	33	
Total productions		434	541	1 051	1 630	1 664	1 755	1 520	1 511	1 361	1 282	1 346	
Total marine capture		434	541	1 051	1 627	1 655	1 747	1 507	1 497	1 342	1 257	1 313	

Table XIV. - State of exploitation, total production and nominal catches by selected species groups fished in the Soutwest Pacific (FAO Statistical Area 81), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t)											State of exploitation
		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	
Gadiformes nei	Japan, Korea Rep, Russian Fed.	0	0	2	0	0	0	8	8	6	9	3	M
Blue grenadier	New Zealand, Japan, Russian Fed.	0	0	27	98	234	210	261	279	277	225	248	U
Red codling	New Zealand, Japan, Russian Fed.	0	1	5	8	5	10	6	5	10	13	11	F
Southern blue whiting	Japan, New Zealand, Russian Fed.	0	0	21	18	21	31	34	53	92	32	19	F
Southern hake	New Zealand, Russian Fed., Korea Rep	0	0	0	1	1	4	4	5	6	7	4	F
Other Cods, hakes, haddocks,..		0	0	0	0	0	0	0	0	0	0	0	?
32-Cods, hakes, haddocks,...		0	1	56	124	261	255	314	350	391	287	284	
Cusk-eels nei	New Zealand, Korea Rep, Australia	0	0	1	3	6	7	7	8	16	16	16	?
Demersal percomorphs nei	Japan, Australia	0	0	14	25	19	13	12	7	14	5	5	?
Golden snapper	New Zealand, Australia, Japan	7	7	16	10	8	8	9	8	8	8	7	F
Oreo dories	New Zealand, Australia, Russian Fed.	0	0	5	28	23	18	21	20	20	24	23	F
Orange roughy	New Zealand, Australia	0	0	1	49	63	67	90	70	55	42	42	F
South Pacific breams	New Zealand, Russian Fed., Ukraine	0	0	2	3	5	3	6	7	8	9	8	F
Other Redfishes,basses,congers		16	20	22	33	44	34	42	38	38	39	34	F
33-Redfishes,basses,congers,..		24	27	59	151	169	150	185	160	160	142	136	F
Mullets nei	Australia, New Zealand	2	3	3	5	6	4	4	4	4	5	4	?M
Greenback horse mackerel	Ukraine, Russian Fed.	0	0	0	37	59	57	68	132	6	12	6	?M
Barracudas	Russian Fed.	0	0	0	0	0	0	1	0	0	1	2	?M
Butterfishes, silver pomfrets	Japan	0	0	7	6	6	5	7	5	5	4	3	?M
Jack and horse mackerels nei	New Zealand, Japan, Korea Rep	0	0	13	19	31	32	36	36	43	50	44	?M
White trevally	New Zealand	1	3	5	4	3	3	3	3	3	3	3	?M
Other Jacks, mullets, sauries,		1	2	3	3	6	4	6	6	4	4	2	?M
34-Jacks, mullets, sauries,...		4	8	32	73	110	105	124	185	66	79	64	
Silver gemfish	New Zealand, Australia	0	0	1	5	7	7	8	7	6	6	4	F
Mackerel-like fishes nei	Australia	0	0	0	0	0	0	0	0	0	0	0	?
Snoek	New Zealand, Japan, Australia	1	0	18	21	20	19	25	21	20	27	17	M
Chub mackerel	Japan, Russian Fed., Ukraine	0	0	0	0	2	1	0	2	3	1	1	?
Hairtails, cutlassfishes, nei		0	0	0	0	0	0	0	0	0	0	0	
Silver scabbardfish	New Zealand	0	0	0	0	0	0	2	3	2	2	2	?
Blue mackerel	New Zealand	0	0	0	2	3	6	8	10	10	10	5	M
Other Mack.,snoeks,cutlassfish		0	0	0	0	0	0	0	0	0	0	0	
37-Mack.,snoeks,cutlassfishes		1	0	20	29	33	33	42	43	41	45	30	

Table XIV continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Australian mussel	Australia	0	0	0	0	0	0	0	0	0	0	0	U
New Zealand mussel	New Zealand	1	2	2	2	0	0	0	0	0	0	0	?
Other Mussels		0	0	0	0	0	0	0	0	0	0	0	?
54-Mussels		1	2	2	2	0	0	0	0	0	0	0	U
Cuttlefishes, bobtail squids	Australia	0	0	0	0	0	0	0	0	0	0	0	U
Common squids	Australia	0	0	0	1	1	1	1	1	1	2	1	U
Squids nei	Russian Fed., Korea Rep, Ukraine	0	0	6	60	52	74	45	39	58	32	50	M
Wellington flying squid	New Zealand, Japan	0	0	15	21	22	32	22	24	48	29	58	M
Octopuses	New Zealand	0	0	0	0	0	0	0	0	0	0	0	M
Other Squid,cuttlefish,octopus		0	0	0	0	0	0	0	0	0	0	0	
57-Squid,cuttlefish,octopuses		0	0	21	83	75	107	68	64	108	64	109	
Selected groups		31	39	190	463	649	650	734	802	765	617	623	
Other groups		25	88	117	108	104	132	93	104	105	105	95	
Total aquaculture		0	0	0	12	30	31	33	54	57	58	59	
Total productions		56	127	307	583	783	813	860	960	927	780	777	
Total marine capture		56	127	307	571	753	782	827	906	870	722	718	

Table XV. - State of exploitation, total production and nominal catches by selected species groups fished in the Southeast Pacific (FAO Statistical Area 87), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
South Pacific hake	Peru, Chile	66	97	166	92	150	156	225	140	92	131	232	F-O
Patagonian grenadier	Chile	0	0	1	74	212	227	128	165	214	83	81	F-O
Patagonian hake	Chile	0	0	4	44	69	57	52	40	38	20	23	F-O
Other Cods, hakes, haddocks,..		0	0	7	7	13	10	9	5	10	31	6	
32-Cods, hakes, haddocks, ..		66	97	179	216	443	451	414	350	354	264	343	
Antarctic toothfishes nei	Chile	0	0	0	3	4	7	9	11	27	21	21	
Other Redfishes,basses,congers		27	38	55	83	104	92	78	45	40	39	51	
33-Redfishes,basses,congers,..		27	38	55	86	108	99	88	56	67	60	72	
Chilean jack mackerel	Chile, Peru, Ecuador	3	16	474	2 292	3 246	3 655	3 828	3 954	3 372	3 348	4 255	M-F
Other Jacks, mullets, sauries,		2	5	19	31	30	47	41	10	23	16	52	M
34-Jacks, mullets, sauries,...		6	21	494	2 323	3 276	3 702	3 869	3 963	3 394	3 364	4 307	
South American pilchard	Peru, Chile	0	3	807	4 583	5 383	4 528	4 254	4 190	3 042	1 624	1 793	(D),F-O
Araucanian herring	Chile	14	58	81	47	30	164	299	584	452	244	341	F-O
Anchoveta(=Peruvian anchovy)	Peru, Chile	345	8 166	4 605	2 147	3 613	5 408	3 772	4 017	5 489	8 300	11 897	(R), F-O
Pacific thread herring	Ecuador	0	0	0	39	38	90	42	23	29	20	36	F
Other Herrings,sardines,anchov		12	11	21	45	36	38	47	44	107	111	70	
35-Herrings,sardines,anchovies		371	8 239	5 514	6 862	9 100	10 227	8 412	8 858	9 118	10 300	14 138	
Eastern Pacific bonito	Peru, Chile	63	84	29	18	35	27	40	25	55	46	50	R-M
Yellowfin tuna	Ecuador, Colombia, Venezuela	6	9	28	37	70	74	88	83	84	70	53	
Bigeye tuna	Japan, Ecuador, Korea Rep	0	3	7	12	7	11	24	16	12	10	9	
Skipjack tuna	Ecuador, Colombia, Venezuela	15	26	23	25	24	40	47	46	69	41	23	
Other Tunas,bonitos,billfishes		3	4	5	8	10	12	28	26	20	11	18	
36-Tunas,bonitos,billfishes,..		87	126	92	100	145	164	228	195	240	178	153	
Chub mackerel	Ecuador, Chile, Peru	5	16	315	306	236	245	402	294	112	159	79	M
Other Mack.,snoeks,cutlassfish		9	9	3	2	7	3	5	4	1	0	1	
37-Mack.,snoeks,cutlassfishes		14	26	318	309	244	248	408	297	113	160	79	
Squids nei	Japan, Korea Rep, Chile	0	0	0	2	0	0	2	48	55	120	150	M
Jumbo flying squid	Peru	0	0	0	1	1	3	7	21	13	8	43	M
Other Squid,cuttlefish,octopus		0	1	0	3	6	7	11	4	5	5	6	
57-Squid,cuttlefish,octopuses		0	1	1	6	7	10	21	72	73	132	199	

Table XV continued

Stock or species group	1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Selected groups	571	8 547	6 652	9 902	13 323	14 900	13 440	13 793	13 359	14 457	19 291	
Other groups	57	127	252	345	376	355	433	364	304	261	288	
Total aquaculture	0	0	0	35	79	82	101	141	162	149	191	
Total productions	628	8 674	6 904	10 282	13 778	15 337	13 974	14 298	13 825	14 867	19 770	
Total marine capture	628	8 674	6 904	10 247	13 699	15 255	13 873	14 157	13 663	14 718	19 579	

Table XVI. - State of exploitation, total production and nominal catches by selected species groups fished in the Southern Oceans (FAO Statistical Area 48,58,88), in metric tonnes, years 1950-94

Stock or species group	Main fishing countries in 94	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
AREA 48													
Mackerel icefish		0	0	32	47	36	22	11	0	0	0	0	D
Antarctic rockcods,noties nei		0	0	0	0	0	0	0	0	0	0	0	D
Blackfin icefish		0	0	1	1	0	0	0	0	0	0	0	D
Patagonian toothfish	Russian Fed., Chile	0	0	0	1	2	4	8	4	5	3	0	F
Other Redfishes,basses,congers		0	11	63	30	25	16	1	0	0	0	0	
33-Redfishes,basses,congers,..		0	11	97	79	63	42	19	4	5	3	0	
Lanternfishes	Russian Fed.	0	0	0	5	15	30	24	78	52	0	0	U
34-Jacks, mullets, sauries,...		0	0	0	5	15	30	24	78	52	0	0	
Antarctic krill	Japan, Ukraine, Poland	0	0	48	297	364	395	344	354	305	83	80	U
46-Krill,planct. crustaceans..		0	0	48	297	364	395	344	354	305	83	80	U
Selected groups		0	11	145	381	443	467	388	437	362	86	81	
Other groups		0	0	4	7	1	0	0	1	0	0	0	
Total aquaculture		0	0	0	0	0	0	0	0	0	0	0	
Total productions		0	11	149	388	444	467	388	438	362	86	81	
Total marine capture		0	11	149	388	444	467	388	438	362	86	81	
AREA 58													
Mackerel icefish	France	0	0	22	11	2	24	1	13	0	0	0	D
Patagonian toothfish	France, Ukraine	0	0	0	1	1	2	1	2	9	3	5	F
Antarctic silverfish		0	0	0	0	0	0	0	0	0	0	0	
Other Redfishes,basses,congers		0	0	43	9	5	5	3	1	0	0	0	R
33-Redfishes,basses,congers,..		0	0	65	21	8	31	5	16	9	3	5	F
Antarctic krill	Japan	0	0	14	58	6	0	30	1	0	6	1	U
46-Krill,planct. crustaceans..		0	0	14	58	6	0	30	1	0	6	1	
Selected groups		0	0	78	79	15	31	34	18	9	8	6	
Other groups		0	0	2	0	0	0	0	0	0	0	0	
Total aquaculture		0	0	0	0	0	0	0	0	0	0	0	
Total productions		0	0	80	79	15	31	34	18	9	8	6	
Total marine capture		0	0	80	79	15	31	34	18	9	8	6	

Table XVI Continued

Stock or species group	1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
AREA 88												
Lanternfishes	0	0	0	0	0	1	0	0	0	0	0	U
34-Jacks, mullets, sauries,...	0	0	0	0	0	1	0	0	0	0	0	
Antarctic krill	0	0	1	3	0	0	1	1	0	0	0	U
46-Krill,planct. crustaceans..	0	0	1	3	0	0	1	1	0	0	0	
Selected groups	0	0	1	4	0	1	1	1	0	0	0	
Other groups	0	0	0	0	0	0	0	0	0	0	0	
Total aquaculture	0	0	0	0	0	0	0	0	0	0	0	
Total productions	0	0	1	4	0	1	1	1	0	0	0	
Total marine capture	0	0	1	4	0	1	1	1	0	0	0	

Table XVII. - State of exploitation and nominal catches of selected tuna and tuna-like species, in all Oceans (FAO's statistical areas 21, 27, 31, 34, 37, 41, 47, 48, 51, 57, 58, 61, 67, 71, 77, 81, 87, 88), in metric tonnes years, 1950-94.

Stock or species group	Main fishing countries 1994	Catches ('000t) 1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Atlantic Ocean (FAO statistical areas 21, 27, 31, 34, 37, 41, 47 and 48)													
Albacore	Other Asia,Spain, France	25	65	75	67	69	63	69	54	63	69	60	North: F. South: O
Bigeye tuna	Japan, Spain, Other Asia	7	20	53	64	56	69	66	71	73	93	105	O
Northern bluefin tuna	Spain, Japan, USA	25	25	20	23	26	24	24	25	28	30	37	West: D. East: F
Southern bluefin tuna	Japan, Other Asia	0	1	7	5	2	2	2	3	3	4	2	D
Skipjack tuna	Spain, France, Ghana	1	11	80	126	139	114	135	195	148	172	167	M
Yellowfin tuna	Spain, France, Venezuela	9	49	105	141	125	151	170	158	150	144	149	F
Total: principal marked tunas		68	171	339	426	418	423	466	507	464	511	520	
Billfishes and swordfish	Spain, Japan, Other Asia	6	18	21	40	55	56	48	42	44	48	53	
Other tunas other and tuna-like species		72	77	81	117	134	123	124	111	92	94	84	
Total: all tunas and tuna-like species		145	266 +		583	608	602	638	660	601	652	658	
Indian Ocean (FAO statistical areas 51, 57 and 58)													
Albacore	Other Asia, Spain, Japan	0	9	11	19	28	23	29	26	18	15	16	? F
Bigeye tuna	Other Asia, Japan, Korea	0	13	25	42	54	45	45	46	39	55	65	? F
Southern bluefin tuna	Japan, Australia, Other Asia	13	28	24	25	19	14	11	7	5	4	4	? D
Skipjack tuna	Maldives, Spain, France	18	29	36	123	212	249	222	224	282	249	257	M-F
Yellowfin tuna	Spain, Other Asia, France	3	28	34	98	183	172	187	191	251	328	254	? F
Total: principal marked tunas		33	108	130	308	496	503	494	493	594	652	595	
Total: billfishes and swordfish	Ski Lanka, Other Asia, India	0	7	7	14	21	20	22	24	27	36	44	Swordfish: ? U
Other tunas and tuna-like species		14	43	70	191	270	267	281	288	273	297	314	
Total: all tunas and tuna-like species		54	167	231	529	796	806	815	821	914	1 006	968	

Table XVII continued

Stock or species group		1950-59	1960-69	1970-79	1980-89	1988	1989	1990	1991	1992	1993	1994	State of exploitation
Pacific Ocean (FAO statistical areas 61, 67, 71, 77, 81, 87 and 88)													
Albacore	Japan, Other Asia, USA	75	106	119	116	129	158	134	89	135	107	117	North: F. South: F
Bigeye tuna	Japan, Korea, China	40	92	104	123	121	126	163	144	159	134	124	F
Northern bluefin tuna	Japan, USA, Other Asia	13	24	19	15	7	9	6	6	7	9	9	? F-O
Southern bluefin tuna	Australia, Japan, New Zealand	4	19	13	5	2	2	3	2	5	6	6	U
Skipjack tuna	Japan, USA, Korea	183	237	477	734	935	867	948	1 148	998	1 040	1 038	East:F. Center-West:U
Yellowfin tuna	Mexico, Japan, USA	139	196	344	486	600	653	709	667	723	689	672	
Total: principal marked tunas		453	673	1 077	1 478	1 794	1 816	1 963	2 056	2 027	1 985	1 967	
Total: billfishes and swordfish	Japan, Other Asia, Philippines	47	75	60	65	73	75	81	79	86	88	69	
Other tunas and tuna-like species		160	241	339	620	797	814	915	896	878	846	912	
Total: all tunas and tuna-like species		660	990	1 476	2 163	2 664	2 706	2 959	3 031	2 991	2 919	2 949	
Total: all principal market tunas for all oceans		549	946	1 536	2 194	2 686	2 722	2 905	3 036	3 065	3 129	3 054	
Total: all billfishes and swordfish for all oceans		50	97	83	107	129	133	141	135	145	161	153	
Total: other tunas and tuna-like species for all oceans		211	328	472	896	1 164	1 182	1 283	1 260	1 220	1 207	1 289	
Total: all tuna and tuna-like species for all oceans		817	1 380	2 114	3 212	3 989	4 053	4 347	4 446	4 450	4 517	4 512	